

YAMAHA SINGLE-AXIS ROBOT

FLIP-X Series

Maintenance Manual

T4L/T4LH/T5L/T5LH/T6L/T9/T9H
F8/F8L/F8LH/F10/F14/F14H/F17/F17L/F20/F20N
N15/N15D/N18/N18D
B10/B14/B14H
R5/R10/R20

Safety Instructions

1. Safety Information	S-1
2. Signal words used in this manual	S-2
3. Warning labels	S-3
3.1 Warning labels	S-3
3.1.1 Warning label messages	S-3
3.1.2 Supplied warning labels	S-5
3.2 Warning symbols	S-6
4. Major precautions for each stage of use	S-7
4.1 Precautions for using robots and controllers	S-7
4.2 Design	S-8
4.2.1 Precautions for robots	S-8
4.2.2 Precautions for robot controllers	S-8
4.3 Moving and installation	S-9
4.3.1 Precautions for robots	S-9
4.3.2 Precautions for robot controllers	S-10
4.4 Safety measures	S-12
4.4.1 Safety measures	S-12
4.4.2 Installing a safety enclosure	S-13
4.5 Operation	S-14
4.5.1 Trial operation	S-14
4.5.2 Automatic operation	S-16
4.5.3 Precautions during operation	S-16
4.6 Inspection and maintenance	S-18
4.6.1 Before inspection and maintenance work	S-18
4.6.2 Precautions during service work	S-19
4.7 Disposal	S-20
5. Emergency action when a person is caught by robot	S-21
6. Using the robot safely	S-22
6.1 Robot safety functions	S-22
6.2 Special training for industrial robot operation	S-23

Warranty

Chapter 1 Overview

1. Overview	1-1
--------------------	------------

Chapter 2 Periodic inspection

1. Before beginning work	2-1
2. Periodic inspection	2-2
2.1 Daily inspection	2-2
2.2 Three-month inspection	2-3
2.3 Six-month inspection	2-5
2.4 Three-year inspection	2-6
3. Applying the grease	2-7
3.1 T4L/T4LH/T5L/T5LH/T6L	2-8
3.2 T9/T9H/F10/F14/F14H/F17/F17L/F20/F20N	2-9
3.3 F8/F8L/F8LH	2-10
3.4 N15/N15D/N18/N18D	2-11
3.5 B10/B14/B14H	2-12

Chapter 3 Adjustment

1. Adjusting the alignment (B10/B14/B14H)	3-1
2. Adjusting the timing belt tension (B10/B14/B14H)	3-2
2.1 Adjusting the drive belt tension	3-3
2.2 Adjusting the speed reduction belt tension	3-4
3. Adjusting the timing belt tension (F20N)	3-6
3.1 Installing and removing the cover	3-6
3.1.1 Stroke cover	3-6
3.1.2 Belt cover	3-8
3.1.3 Motor cover	3-9
3.2 Adjusting the timing belt tension	3-10
4. Adjusting shutter looseness (T4L/T4LH/T5L/T5LH/T6L)	3-11

Chapter 4 Replacement

1. Replacing the shutter (T4L/T4LH/T5L/T5LH/T6L)	4-1
2. Replacing the motor	4-3
2.1 T4L/T4LH/T5L/T5LH/T6L	4-3

2.2	F8/F8L/F8LH	4-5
2.3	B10/B14/B14H	4-8
2.4	F20N	4-9
2.5	N15/N15D/N18/N18D	4-11
2.6	Checking the grid position	4-15
3. Replacing the insert (T4L/T4LH/T5L/T5LH/T6L)		4-16
4. Replacing the drive and speed reduction belts (B10/B14/B14H)		4-18
4.1	Replacing the drive belt	4-18
4.2	Replacing the speed reduction belt	4-20
5. Replacing the slider		4-21
5.1	B10/B14/B14H	4-21
5.2	F20N	4-22
6. Maintenance parts		4-23
6.1	Consumable parts	4-23

Chapter 5 Wiring specifications

1. AC servo motor specifications		5-1
1.1	AC servo motor termination (T4L/T5L)	5-1
1.2	AC servo motor termination (T4LH/T5LH/T6L)	5-2
1.3	AC servo motor termination (F8/F8L/F8LH)	5-3
1.4	AC servo motor termination (T9/T9H/F10/F14/F14H/F17/F17L/F20)	5-4
1.5	AC servo motor termination (B10/B14/B14H/R5/R10/R20/F20N/N15/N18)	5-5
1.6	Brake cable specifications	5-6
2. Robot cables (DC24V specifications) (T4L/T5L)		5-7
2.1	Single-axis robot cables	5-7
2.1.1	Cables for ERCD	5-7
3. Robot cables (200V specifications) (T4LH/T5LH/T6L/T9/T9H/F8/F8L/F8LH/F10/F14/F14H/F17/F17L/F20/B10/B14/B14H/R5/R10/R20)		5-8
3.1	Single-axis robot cables	5-8
3.1.1	Cables for TS-X	5-8
3.1.2	Cables for SR1-X	5-9
3.1.3	Cables for RDX (robot with brake)	5-10
3.1.4	Cables for RDX (robot without brake)	5-12
3.2	Multi-robot cables	5-13
3.2.1	Cables for single-axis multi-robot	5-13
3.2.2	Cables for two-axis multi-robot	5-14

CONTENTS

FLIP-X
Maintenance Manual

4. Machine harness	5-20
4.1 N15/N15D/N18/N18D	5-20
4.2 F20N	5-21

5. Cables models	5-22
5.1 Single-axis robot cables	5-22
5.2 Multi-robot cables	5-23

Safety Instructions

Contents

1. Safety Information	S-1
2. Signal words used in this manual	S-2
3. Warning labels	S-3
3.1 Warning labels	S-3
3.1.1 Warning label messages	S-3
3.1.2 Supplied warning labels	S-5
3.2 Warning symbols	S-6
4. Major precautions for each stage of use	S-7
4.1 Precautions for using robots and controllers	S-7
4.2 Design	S-8
4.2.1 Precautions for robots	S-8
4.2.2 Precautions for robot controllers	S-8
4.3 Moving and installation	S-9
4.3.1 Precautions for robots	S-9
4.3.2 Precautions for robot controllers	S-10
4.4 Safety measures	S-12
4.4.1 Safety measures	S-12
4.4.2 Installing a safety enclosure	S-13
4.5 Operation	S-14
4.5.1 Trial operation	S-14
4.5.2 Automatic operation	S-16
4.5.3 Precautions during operation	S-16
4.6 Inspection and maintenance	S-18
4.6.1 Before inspection and maintenance work	S-18
4.6.2 Precautions during service work	S-19
4.7 Disposal	S-20
5. Emergency action when a person is caught by robot	S-21
6. Using the robot safely	S-22
6.1 Robot safety functions	S-22
6.2 Special training for industrial robot operation	S-23

1. Safety Information

Industrial robots are highly programmable, mechanical devices that provide a large degree of freedom when performing various manipulative tasks. To ensure safe and correct use of YAMAHA industrial robots and controllers, carefully read and comply with the safety instructions and precautions in this "Safety Instructions" guide. Failure to take necessary safety measures or incorrect handling may result in trouble or damage to the robot and controller, and also may cause personal injury (to installation personnel, robot operator or service personnel) including fatal accidents.

Before using this product, read this manual and related manuals and take safety precautions to ensure correct handling.

The precautions listed in this manual relate to this product. To ensure safety of the user's final system that includes YAMAHA robots, please take appropriate safety measures as required by the user's individual system.

To use YAMAHA robots and controllers safely and correctly, always comply with the safety rules and instructions.

- For specific safety information and standards, refer to the applicable local regulations and comply with the instructions.
- This manual and warning labels supplied with or attached to the robot are written in English. Unless the robot operators or service personnel understand English, do not permit them to handle the robot.
- Cautions regarding the official language of EU countries
For equipment that will be installed in EU countries, the language used for the manuals, warning labels, operation screen characters, and CE declarations is English only.
Warning labels only have pictograms or else include warning messages in English. In the latter case, messages in Japanese or other languages might be added.

It is not possible to list all safety items in detail within the limited space of this manual. So please note that it is essential that the user have a full knowledge of safety and also make correct judgments on safety procedures.

Refer to the manual by any of the following methods when installing, operating or adjusting the robot and controller.

1. Install, operate or adjust the robot and controller while referring to the printed version of the manual (available for an additional fee).
2. Install, operate or adjust the robot and controller while viewing the CD-ROM version of the manual on your computer screen.
3. Install, operate or adjust the robot and controller while referring to a printout of the necessary pages from the CD-ROM version of the manual.

2. Signal words used in this manual

This manual uses the following safety alert symbols and signal words to provide safety instructions that must be observed and to describe handling precautions, prohibited actions, and compulsory actions. Make sure you understand the meaning of each symbol and signal word and then read this manual.



DANGER

THIS INDICATES AN IMMEDIATELY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.



WARNING

THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.



CAUTION

This indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury, or damage to the equipment.



NOTE

Explains the key point in the operation in a simple and clear manner.

3. Warning labels

Warning labels shown below are attached to the robot body and controller to alert the operator to potential hazards. To ensure correct use, read the warning labels and comply with the instructions.

3.1 Warning labels



WARNING

IF WARNING LABELS ARE REMOVED OR DIFFICULT TO SEE, THEN THE NECESSARY PRECAUTIONS MAY NOT BE TAKEN, RESULTING IN AN ACCIDENT.

- DO NOT REMOVE, ALTER OR STAIN THE WARNING LABELS ON THE ROBOT BODY.
- DO NOT ALLOW WARNING LABELS TO BE HIDDEN BY DEVICES INSTALLED ON THE ROBOT BY THE USER.
- PROVIDE PROPER LIGHTING SO THAT THE SYMBOLS AND INSTRUCTIONS ON THE WARNING LABELS CAN BE CLEARLY SEEN FROM OUTSIDE THE SAFETY ENCLOSURE.

3.1.1 Warning label messages

Word messages on the danger, warning and caution labels are concise and brief instructions. For more specific instructions, read and follow the "Instructions on this label" described on the right of each label shown below.

1. Warning label 1 (SCARA robots, Cartesian robots)



DANGER

SERIOUS INJURY MAY RESULT FROM CONTACT WITH A MOVING ROBOT.

- KEEP OUTSIDE OF THE ROBOT SAFETY ENCLOSURE DURING OPERATION.
- PRESS THE EMERGENCY STOP BUTTON BEFORE ENTERING THE SAFETY ENCLOSURE.

	Instructions on this label
 90K41-001470	• Always install a safety enclosure to keep all persons away from the robot movement range and prevent injury from contacting the moving part of the robot. • Install an interlock that triggers emergency stop when the door or gate of the safety enclosure is opened. • The safety enclosure should be designed so that no one can enter inside except from the door or gate equipped with an interlock device. • Warning label 1 that comes supplied with a robot should be affixed to an easy-to-see location on the door or gate of the safety enclosure.

90K41-001470

2. Warning label 2 (SCARA robots, Cartesian robots, single-axis robots*)

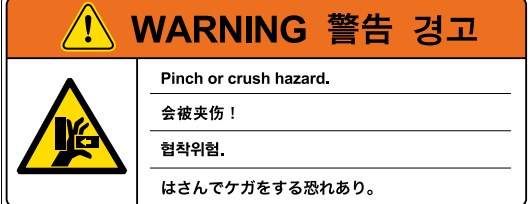
* Warning label 2 is not attached to some small single-axis robots, but is supplied with the robots.



WARNING

MOVING PARTS CAN PINCH OR CRUSH HANDS.

KEEP HANDS AWAY FROM THE MOVABLE PARTS OF THE ROBOT.

	Instructions on this label
 90K41-001460	Use caution to prevent hands and fingers from being pinched or crushed by the movable parts of the robot when transporting or moving the robot or during teaching.

90K41-001460

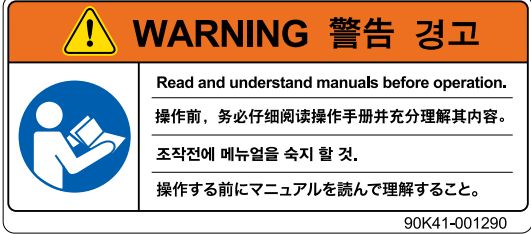
3. Warning label 3 (SCARA robots, Cartesian robots)



WARNING

IMPROPER INSTALLATION OR OPERATION MAY CAUSE SERIOUS INJURY.

BEFORE INSTALLING OR OPERATING THE ROBOT, READ THE MANUAL AND INSTRUCTIONS ON THE WARNING LABELS AND UNDERSTAND THE CONTENTS.

	Instructions on this label
	• Be sure to read the warning label and this manual carefully to make you completely understand the contents before attempting installation and operation of the robot. • Before starting the robot operation, even after you have read through this manual, read again the corresponding procedures and "Safety instructions" in this manual. • Never install, adjust, inspect or service the robot in any manner that does not comply with the instructions in this manual.

90K41-001290

4. Warning label 4 (SCARA robots)



CAUTION

Do not remove the parts on which Warning label 4 is attached.

Doing so may damage the ball screw.

	Instructions on this label
	The Z-axis ball screw will be damaged if the upper end mechanical stopper on the Z-axis spline is removed or moved. Never attempt to remove or move it.

90K41-001520

5. "Read instruction manual" label (Controller)*



CAUTION

Refer to the manual.

	Instructions on this label
	This indicates important information that you must know and is described in the manual. Before using the controller, be sure to read the manual thoroughly. When adding external safety circuits or connecting a power supply to the controller, read the manual carefully and make checks before beginning the work. Connectors must be attached while facing a certain direction, so insert each connector in the correct direction.

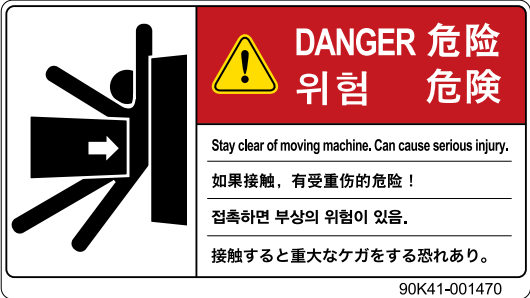
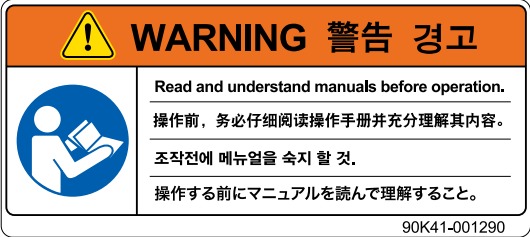
93005-X0-00

* This label is attached near the power input connector on the front panel.

3.1.2 Supplied warning labels

Some warning labels are not affixed to robots but included in the packing box. These warning labels should be affixed to an easy-to-see location.

- Warning label is attached to the robot body.
- Warning label comes supplied with the robot and should be affixed to an easy-to-see location on the door or gate of the safety enclosure.
- ◎ Warning label comes supplied with the robot and should be affixed to an easy-to-see location.

		SCARA robots	Cartesian robots	Single-axis robots
Warning label 1		●*1 ○	● ○	○
Warning label 2		●*1	●	●*2
Warning label 3		●*1	●	◎
Warning label 4		●*1		

*1: For the label positions, see the SCARA robot user's manual ("1.2 Part names" in Chapter 1).

*2: This label is not attached to some small single-axis robots, but is supplied with the robots.

3.2 Warning symbols

Warning symbols shown below are printed on the robot and controller to alert the operator to potential hazards. To use the YAMAHA robot safely and correctly always follow the instructions and cautions indicated by the symbols.

1. Electrical shock hazard symbol



WARNING

TOUCHING THE TERMINAL BLOCK OR CONNECTOR MAY CAUSE ELECTRICAL SHOCK, SO USE CAUTION.

	Instructions by this symbol
	This indicates a high voltage is present. Touching the terminal block or connector may cause electrical shock.

93006-X0-00

2. High temperature hazard symbol



WARNING

MOTORS, HEATSINKS, AND REGENERATIVE UNITS BECOME HOT, SO DO NOT TOUCH THEM.

	Instructions by this symbol
	This indicates the area around this symbol may become very hot. Motors, heatsinks, and regenerative units become hot during and shortly after operation. To avoid burns be careful not to touch those sections.

93008-X0-00

3. Caution symbol



CAUTION

Always read the manual carefully before using the controller.

	Instructions by this symbol
	This indicates important information that you must know and is described in the manual. Before using the controller, be sure to read the manual thoroughly. When adding external safety circuits or connecting a power supply to the controller, read the manual carefully and make checks before beginning the work. Connectors must be attached while facing a certain direction, so insert each connector in the correct direction.

93007-X0-00

4. Major precautions for each stage of use

This section describes major precautions that must be observed when using robots and controllers. Be sure to carefully read and comply with all of these precautions even if there is no alert symbol shown.

4.1 Precautions for using robots and controllers

General precautions for using robots and controllers are described below.

1. Applications where robots cannot be used

YAMAHA robots and robot controllers are designed as general-purpose industrial equipment and cannot be used for the following applications.



DANGER

YAMAHA ROBOT CONTROLLERS AND ROBOTS ARE DESIGNED AS GENERAL-PURPOSE INDUSTRIAL EQUIPMENT AND CANNOT BE USED FOR THE FOLLOWING APPLICATIONS.

- IN MEDICAL EQUIPMENT SYSTEMS WHICH ARE CRITICAL TO HUMAN LIFE
- IN SYSTEMS THAT SIGNIFICANTLY AFFECT SOCIETY AND THE GENERAL PUBLIC
- IN EQUIPMENT INTENDED TO CARRY OR TRANSPORT PEOPLE
- IN ENVIRONMENTS WHICH ARE SUBJECT TO VIBRATION SUCH AS ONBOARD SHIPS AND VEHICLES.

2. Qualification of operators/workers

Operators or persons who handle the robot such as for teaching, programming, movement check, inspection, adjustment, and repair must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must read the manual carefully to understand its contents before attempting the robot operation or maintenance.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and standards for industrial robots.



WARNING

- THE ROBOT MUST BE OPERATED ONLY BY PERSONS WHO HAVE RECEIVED SAFETY AND OPERATION TRAINING. OPERATION BY AN UNTRAINED PERSON IS EXTREMELY HAZARDOUS.
- ADJUSTMENT AND MAINTENANCE BY REMOVING A COVER REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS, AND MAY ALSO INVOLVE HAZARDS IF ATTEMPTED BY AN UNSKILLED PERSON. THESE TASKS MUST BE PERFORMED ONLY BY PERSONS WHO HAVE ENOUGH ABILITY AND QUALIFICATIONS IN ACCORDANCE WITH LOCAL LAWS AND REGULATIONS. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

4.2 Design

4.2.1 Precautions for robots

1. Provide safety measures for end effector (gripper, etc.)



WARNING

- END EFFECTORS MUST BE DESIGNED AND MANUFACTURED SO THAT THEY CAUSE NO HAZARDS (SUCH AS A LOOSE WORKPIECE OR LOAD) EVEN IF POWER (ELECTRICITY, AIR PRESSURE, ETC.) IS SHUT OFF OR POWER FLUCTUATIONS OCCUR.
- IF THE OBJECT GRIPPED BY THE END EFFECTOR MIGHT POSSIBLY FLY OFF OR DROP, THEN PROVIDE APPROPRIATE SAFETY PROTECTION TAKING INTO ACCOUNT THE OBJECT SIZE, WEIGHT, TEMPERATURE, AND CHEMICAL PROPERTIES.

2. Provide adequate lighting

Provide enough lighting to ensure safety during work.

3. Install an operation status light



WARNING

INSTALL A SIGNAL LIGHT (SIGNAL TOWER) AT AN EASY-TO-SEE POSITION SO THAT THE OPERATOR WILL BE AWARE OF THE ROBOT STOP STATUS (TEMPORARILY STOPPED, EMERGENCY STOP, ERROR STOP, ETC.).

4. Do not use robots for tasks requiring motor thrust



CAUTION

Avoid using the belt-driven robots for tasks which make use of motor thrust (press-fitting, burr removal, etc.). These tasks may cause the robot to malfunction.

5. Clean work tools

Work tools such as welding guns and paint nozzles mounted on the robot manipulator tip should preferably be cleaned automatically when needed.

4.2.2 Precautions for robot controllers

1. Emergency stop input terminal



DANGER

EACH ROBOT CONTROLLER HAS AN EMERGENCY STOP INPUT TERMINAL TO TRIGGER EMERGENCY STOP. USING THIS TERMINAL, INSTALL A SAFETY CIRCUIT SO THAT THE SYSTEM INCLUDING THE ROBOT CONTROLLER WILL WORK SAFELY.

2. Maintain clearance



CAUTION

Do not bundle control lines or communication cables together or in close to the main power supply or power lines. Usually separate these by at least 100mm. Failure to follow this instruction may cause malfunction due to noise.

4.3 Moving and installation

4.3.1 Precautions for robots

■ Installation environment

1. Do not use in strong magnetic fields

**WARNING**

DO NOT USE THE ROBOT NEAR EQUIPMENT OR IN LOCATIONS THAT GENERATE STRONG MAGNETIC FIELDS. THE ROBOT MAY BREAKDOWN OR MALFUNCTION IF USED IN SUCH LOCATIONS.

2. Do not use in locations subject to possible electromagnetic interference, etc.

**WARNING**

DO NOT USE THE ROBOT IN LOCATIONS SUBJECT TO ELECTROMAGNETIC INTERFERENCE, ELECTROSTATIC DISCHARGE OR RADIO FREQUENCY INTERFERENCE. THE ROBOT MAY MALFUNCTION IF USED IN SUCH LOCATIONS CREATING HAZARDOUS SITUATIONS.

3. Do not use in locations exposed to flammable gases

**WARNING**

- YAMAHA ROBOTS ARE NOT DESIGNED TO BE EXPLOSION-PROOF.
- DO NOT USE THE ROBOTS IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, DUST PARTICLES OR LIQUID. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, OR LEAD TO FIRE.

■ Moving

1. Use caution to prevent pinching or crushing of hands or fingers

**WARNING**

MOVING PARTS CAN PINCH OR CRUSH HANDS OR FINGERS.
KEEP HANDS AWAY FROM THE MOVABLE PARTS OF THE ROBOT.

As instructed in Warning label 2, use caution to prevent hands or fingers from being pinched or crushed by movable parts when transporting or moving the robot. For details on warning labels, see "3. Warning labels" in "Safety instructions."

2. Take safety measures when moving the robot

To ensure safety when moving a SCARA robot with an arm length of 500mm or more, use the eyebolts that come supplied with the robot.
Refer to the robot manual for details.

■ Installation

1. Protect electrical wiring and hydraulic/pneumatic hoses

Install a cover or similar item to protect the electrical wiring and hydraulic/pneumatic hoses from possible damage.

■ Wiring

1. Protective measures against electrical shock

**WARNING**

ALWAYS GROUND THE ROBOT TO PREVENT ELECTRICAL SHOCK.

■ Adjustment

1. Adjustment that requires removing a cover



WARNING

YAMAHA ROBOT CONTROLLERS ARE NOT DESIGNED TO BE EXPLOSION-PROOF. DO NOT USE THEM IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, GASOLINE OR SOLVENT. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, OR LEAD TO FIRE. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

4.3.2 Precautions for robot controllers

■ Installation environment

1. Installation environment



WARNING

YAMAHA ROBOTS AND ROBOT CONTROLLERS ARE NOT DESIGNED TO BE EXPLOSION-PROOF. DO NOT USE THEM IN LOCATIONS EXPOSED TO EXPLOSIVE OR INFLAMMABLE GASES, GASOLINE OR SOLVENT. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH, AND LEAD TO FIRE.



WARNING

- USE THE ROBOT CONTROLLER IN LOCATIONS THAT SUPPORT THE ENVIRONMENTAL CONDITIONS SPECIFIED IN THIS MANUAL. OPERATION OUTSIDE THE SPECIFIED ENVIRONMENTAL RANGE MAY CAUSE ELECTRICAL SHOCK, FIRE, MALFUNCTION OR PRODUCT DAMAGE OR DETERIORATION.
- THE ROBOT CONTROLLER AND PROGRAMMING BOX SHOULD BE INSTALLED AT A LOCATION THAT IS OUTSIDE THE ROBOT MOVEMENT RANGE YET WHERE IT IS EASY TO OPERATE AND VIEW ROBOT MOVEMENT.
- INSTALL THE ROBOT CONTROLLER IN LOCATIONS WITH ENOUGH SPACE TO PERFORM WORK (TEACHING, INSPECTION, ETC.) SAFELY. LIMITED SPACE NOT ONLY MAKES IT DIFFICULT TO PERFORM WORK BUT CAN ALSO CAUSE INJURY.
- INSTALL THE ROBOT CONTROLLER IN A STABLE, LEVEL LOCATION AND SECURE IT FIRMLY. AVOID INSTALLING THE CONTROLLER UPSIDE DOWN OR IN A TILTED POSITION.
- PROVIDE SUFFICIENT CLEARANCE AROUND THE ROBOT CONTROLLER FOR GOOD VENTILATION. INSUFFICIENT CLEARANCE MAY CAUSE MALFUNCTION, BREAKDOWN OR FIRE.

■ Installation

To install the robot controller, observe the installation conditions and method described in the manual.

1. Installation



WARNING

SECURELY TIGHTEN THE SCREWS FOR THE L-SHAPED BRACKETS USED TO INSTALL THE ROBOT CONTROLLER. IF NOT SECURELY TIGHTENED, THE SCREWS MAY COME LOOSE CAUSING THE CONTROLLER TO DROP.

2. Connections



WARNING

- ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE STARTING INSTALLATION OR WIRING WORK. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE.
- NEVER DIRECTLY TOUCH CONDUCTIVE SECTIONS AND ELECTRONIC PARTS OTHER THAN THE CONNECTORS, ROTARY SWITCHES, AND DIP SWITCHES ON THE OUTSIDE PANEL OF THE ROBOT CONTROLLER. TOUCHING THEM MAY CAUSE ELECTRICAL SHOCK OR BREAKDOWN.
- SECURELY INSTALL EACH CABLE CONNECTOR INTO THE RECEPTACLES OR SOCKETS. POOR CONNECTIONS MAY CAUSE THE CONTROLLER OR ROBOT TO MALFUNCTION.

■ Wiring

1. Connection to robot controller

The controller parameters are preset at the factory before shipping to match the robot model. Check the specified robot and controller combination, and connect them in the correct combination.

Since the software detects abnormal operation such as motor overloads, the controller parameters must be set correctly to match the motor type used in the robot connected to the controller.

2. Wiring safety points



WARNING

ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE STARTING INSTALLATION OR WIRING WORK. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE.



CAUTION

- Make sure that no foreign matter such as cutting chips or wire scraps get into the robot controller. Malfunction, breakdown or fire may result if these penetrate inside.
- Do not apply excessive impacts or loads to the connectors when making cable connections. This might bend the connector pins or damage the internal PC board.
- When using ferrite cores for noise elimination, be sure to fit them onto the power cable as close to the robot controller and/or the robot as possible, to prevent malfunction caused by noise.

3. Wiring method



WARNING

SECURELY INSTALL THE CONNECTORS INTO THE ROBOT CONTROLLER AND, WHEN WIRING THE CONNECTORS, MAKE THE CRIMP, PRESS-CONTACT OR SOLDER CONNECTIONS CORRECTLY USING THE TOOL SPECIFIED BY THE CONNECTOR MANUFACTURER.



CAUTION

When disconnecting the cable from the robot controller, detach by gripping the connector itself and not by tugging on the cable. Loosen the screws on the connector (if fastened with the screws), and then disconnect the cable. Trying to detach by pulling on the cable itself may damage the connector or cables, and poor cable contact will cause the controller or robot to malfunction.

4. Precautions for cable routing and installation



CAUTION

- Always store the cables connected to the robot controller in a conduit or clamp them securely in place. If the cables are not stored in a conduit or properly clamped, excessive play or movement or mistakenly pulling on the cable may damage the connector or cables, and poor cable contact will cause the controller or robot to malfunction.
- Do not modify the cables and do not place any heavy objects on them. Handle them carefully to avoid damage. Damaged cables may cause malfunction or electrical shock.
- If the cables connected to the robot controller may possibly become damaged, then protect them with a cover, etc.
- Check that the control lines and communication cables are routed at a gap sufficiently away from main power supply circuits and power lines, etc. Bundling them together with power lines or close to power lines may cause faulty operation due to noise.

5. Protective measures against electrical shock



WARNING

BE SURE TO GROUND THE CONTROLLER USING THE GROUND TERMINAL ON THE POWER TERMINAL BLOCK. POOR GROUNDING MAY CAUSE ELECTRICAL SHOCK.

4.4 Safety measures

4.4.1 Safety measures

1. Referring to warning labels and manual



WARNING

- BEFORE STARTING INSTALLATION OR OPERATION OF THE ROBOT, BE SURE TO READ THE WARNING LABELS AND THIS MANUAL, AND COMPLY WITH THE INSTRUCTIONS.
- NEVER ATTEMPT ANY WORK OR OPERATION UNLESS DESCRIBED IN THIS MANUAL.
- NEVER ATTEMPT ANY REPAIR, PARTS REPLACEMENT AND MODIFICATION UNLESS DESCRIBED IN THIS MANUAL. THESE TASKS REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS AND MAY ALSO INVOLVE HAZARDS. PLEASE CONTACT YOUR DISTRIBUTOR FOR ADVICE.



NOTE

For details on warning labels, see "3. Warning labels" in "Safety instructions."

2. Draw up "work instructions" and make the operators/workers understand them



WARNING

DECIDE ON "WORK INSTRUCTIONS" IN CASES WHERE PERSONNEL MUST WORK WITHIN THE ROBOT MOVEMENT RANGE TO PERFORM STARTUP OR MAINTENANCE WORK. MAKE SURE THE WORKERS COMPLETELY UNDERSTAND THESE "WORK INSTRUCTIONS".

Decide on "work instructions" for the following items in cases where personnel must work within the robot movement range to perform teaching, maintenance or inspection tasks. Make sure the workers completely understand these "work instructions".

1. Robot operating procedures needed for tasks such as startup procedures and handling switches
2. Robot speeds used during tasks such as teaching
3. Methods for workers to signal each other when two or more workers perform tasks
4. Steps that the worker should take when a problem or emergency occurs
5. Steps to take after the robot has come to a stop when the emergency stop device was triggered, including checks for cancelling the problem or error state and safety checks in order to restart the robot.
6. In cases other than above, the following actions should be taken as needed to prevent hazardous situations due to sudden or unexpected robot operation or faulty robot operation as listed below.
 - Place a display sign on the operator panel
 - Ensure the safety of workers performing tasks within the robot movement range
 - Clearly specify position and posture during work
Specify a position and posture where worker can constantly check robot movements and immediately move to avoid trouble if an error/problem occurs
 - Take noise prevention measures
 - Use methods for signaling operators of related equipment
 - Use methods to decide that an error has occurred and identify the type of error

Implement the "work instructions" according to the type of robot, installation location, and type of work task.

When drawing up the "work instructions" make an effort to include opinions from the workers involved, equipment manufacturer technicians, and workplace safety consultants, etc.

3. Take safety measures



DANGER

- NEVER ENTER THE ROBOT MOVEMENT RANGE WHILE THE ROBOT IS OPERATING OR THE MAIN POWER IS TURNED ON. FAILURE TO FOLLOW THIS WARNING MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH. INSTALL A SAFETY ENCLOSURE OR A GATE INTERLOCK WITH AN AREA SENSOR TO KEEP ALL PERSONS AWAY FROM THE ROBOT MOVEMENT RANGE.
- WHEN IT IS NECESSARY TO OPERATE THE ROBOT WHILE YOU ARE WITHIN THE ROBOT MOVEMENT RANGE SUCH AS FOR TEACHING OR MAINTENANCE/INSPECTION TASKS, ALWAYS CARRY THE PROGRAMMING BOX WITH YOU SO THAT YOU CAN IMMEDIATELY STOP THE ROBOT OPERATION IN CASE OF AN ABNORMAL OR HAZARDOUS CONDITION. FAILURE TO FOLLOW THIS INSTRUCTION MAY CAUSE SERIOUS ACCIDENTS INVOLVING INJURY OR DEATH.

**WARNING**

- DURING STARTUP OR MAINTENANCE TASKS, DISPLAY A SIGN "WORK IN PROGRESS" ON THE PROGRAMMING BOX AND OPERATION PANEL IN ORDER TO PREVENT ANYONE OTHER THAN THE PERSON FOR THAT TASK FROM MISTAKENLY OPERATING THE START OR SELECTOR SWITCH. IF NEEDED, TAKE OTHER MEASURES SUCH AS LOCKING THE COVER ON THE OPERATION PANEL.
- ALWAYS CONNECT THE ROBOT AND ROBOT CONTROLLER IN THE CORRECT COMBINATION. USING THEM IN AN INCORRECT COMBINATION MAY CAUSE FIRE OR BREAKDOWN.

4. Install system safeguards

When configuring an automated system using a robot, hazardous situations are more likely to occur from the automated system than the robot itself. So the system manufacturer should install the necessary safety measures required for the individual system. The system manufacturer should provide a proper manual for safe, correct operation and servicing of the system.

**WARNING**

TO CHECK THE ROBOT CONTROLLER OPERATING STATUS, REFER TO THIS MANUAL AND TO RELATED MANUALS. DESIGN AND INSTALL THE SYSTEM INCLUDING THE ROBOT CONTROLLER SO THAT IT WILL ALWAYS WORK SAFELY.

5. Precautions for operation**WARNING**

- DO NOT TOUCH ANY ELECTRICAL TERMINAL. DIRECTLY TOUCHING THESE TERMINALS MAY CAUSE ELECTRICAL SHOCK, EQUIPMENT DAMAGE, AND MALFUNCTION.
- DO NOT TOUCH OR OPERATE THE ROBOT CONTROLLER OR PROGRAMMING BOX WITH WET HANDS. TOUCHING OR OPERATING THEM WITH WET HANDS MAY RESULT IN ELECTRICAL SHOCK OR BREAKDOWN.

6. Do not disassemble and modify**WARNING**

NEVER DISASSEMBLE AND MODIFY ANY PART IN THE ROBOT, CONTROLLER, AND PROGRAMMING BOX. DO NOT OPEN ANY COVER. DOING SO MAY CAUSE ELECTRICAL SHOCK, BREAKDOWN, MALFUNCTION, INJURY, OR FIRE.

4.4.2 Installing a safety enclosure

Be sure to install a safety enclosure to keep anyone from entering within the movement range of the robot. The safety enclosure will prevent the operator and other persons from coming in contact with moving parts of the robot and suffering injury.

**DANGER**

SERIOUS INJURY MAY RESULT FROM CONTACT WITH A MOVING ROBOT.

- KEEP OUTSIDE OF THE ROBOT SAFETY ENCLOSURE DURING OPERATION.
- PRESS THE EMERGENCY STOP BUTTON BEFORE ENTERING THE SAFETY ENCLOSURE.

**WARNING**

- INSTALL AN INTERLOCK THAT TRIGGERS EMERGENCY STOP WHEN THE DOOR OR GATE OF THE SAFETY ENCLOSURE IS OPENED.
- THE SAFETY ENCLOSURE SHOULD BE DESIGNED SO THAT NO ONE CAN ENTER INSIDE EXCEPT FROM THE DOOR OR GATE EQUIPPED WITH AN INTERLOCK DEVICE.
- WARNING LABEL 1 (SEE "3. WARNING LABELS" IN "SAFETY INSTRUCTIONS") THAT COMES SUPPLIED WITH A ROBOT SHOULD BE AFFIXED TO AN EASY-TO-SEE LOCATION ON THE DOOR OR GATE OF THE SAFETY ENCLOSURE.

4.5 Operation

When operating a robot, ignoring safety measures and checks may lead to serious accidents. Always take the following safety measures and checks to ensure safe operation.



DANGER

CHECK THE FOLLOWING POINTS BEFORE STARTING ROBOT OPERATION.

- NO ONE IS WITHIN THE ROBOT MOVEMENT RANGE.
- THE PROGRAMMING UNIT IS IN THE SPECIFIED LOCATION.
- THE ROBOT AND PERIPHERAL EQUIPMENT ARE IN GOOD CONDITION.

4.5.1 Trial operation

After installing, adjusting, inspecting, maintaining or repairing the robot, perform trial operation using the following procedures.

1. If a safety enclosure has not yet been provided right after installing the robot:

then rope off or chain off the movement range around the robot in place of the safety enclosure and observe the following points.



DANGER

PLACE A "ROBOT IS MOVING - KEEP AWAY!" SIGN TO KEEP THE OPERATOR OR OTHER PERSONNEL FROM ENTERING WITHIN THE MOVEMENT RANGE OF THE ROBOT.



WARNING

- USE STURDY, STABLE POSTS WHICH WILL NOT FALL OVER EASILY.
- THE ROPE OR CHAIN SHOULD BE EASILY VISIBLE TO EVERYONE AROUND THE ROBOT.

2. Check the following points before turning on the controller.

- Is the robot securely and correctly installed?
- Are the electrical connections to the robot wired correctly?
- Are items such as air pressure correctly supplied?
- Is the robot correctly connected to peripheral equipment?
- Have safety measures (safety enclosure, etc.) been taken?
- Does the installation environment meet the specified standards?

3. After the controller is turned on, check the following points from outside the safety enclosure.

- Does the robot start, stop and enter the selected operation mode as intended?
- Does each axis move as intended within the soft limits?
- Does the end effector move as intended?
- Are the correct signals being sent to the end effector and peripheral equipment?
- Does emergency stop function?
- Are teaching and playback functions normal?
- Are the safety enclosure and interlocks functioning as intended?

4. Working inside safety enclosures

Before starting work within the safety enclosure, **always first confirm from outside the enclosure that each safety function is operating correctly (see the previous section 2.3).**



DANGER

NEVER ENTER WITHIN THE MOVEMENT RANGE WHILE WITHIN THE SAFETY ENCLOSURE.



WARNING

WHEN WORK IS REQUIRED WITHIN THE SAFETY ENCLOSURE, PLACE A SIGN "WORK IN PROGRESS" IN ORDER TO KEEP OTHER PERSONS FROM OPERATING THE CONTROLLER SWITCH OR OPERATION PANEL.



WARNING

WHEN WORK WITHIN THE SAFETY ENCLOSURE IS REQUIRED, ALWAYS TURN OFF THE CONTROLLER POWER EXCEPT FOR THE FOLLOWING CASES:

Exception

Work with power turned on, but robot in emergency stop

Origin position setting	SCARA robots	Follow the precautions and procedure described in "2. Adjusting the origin position" in Chapter 3.
Reference coordinate setting	SCARA robots	Follow the precautions and procedure described in "4. Setting the reference coordinates" in Chapter 3.
Soft limit settings	SCARA robots	Follow the precautions and procedure described in "3. Setting the soft limits" in Chapter 3.
	Cartesian robots Single-axis robots	Follow the precautions and procedure described in "Soft limit" in each controller manual.

Work with power turned on

Teaching	SCARA robots Cartesian robots Single-axis robots	Refer to "5. Teaching within safety enclosure" described below.
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5. Teaching within the safety enclosure

When performing teaching within the safety enclosure, check or perform the following points **from outside the safety enclosure.**



DANGER

NEVER ENTER WITHIN THE MOVEMENT RANGE WHILE WITHIN THE SAFETY ENCLOSURE.



WARNING

- MAKE A VISUAL CHECK TO ENSURE THAT NO HAZARDS ARE PRESENT WITHIN THE SAFETY ENCLOSURE.
- CHECK THAT THE PROGRAMMING BOX OR HANDY TERMINAL OPERATES CORRECTLY.
- CHECK THAT NO FAILURES ARE FOUND IN THE ROBOT.
- CHECK THAT EMERGENCY STOP WORKS CORRECTLY.
- SELECT TEACHING MODE AND DISABLE AUTOMATIC OPERATION.

4.5.2 Automatic operation

Check the following points when operating the robot in AUTO mode. Observe the instructions below in cases where an error occurs during automatic operation. Automatic operation described here includes all operations in AUTO mode.

1. Checkpoints before starting automatic operation

Check the following points before starting automatic operation



DANGER

- CHECK THAT NO ONE IS WITHIN THE SAFETY ENCLOSURE.
- CHECK THE SAFETY ENCLOSURE IS SECURELY INSTALLED WITH INTERLOCKS FUNCTIONAL.



WARNING

- CHECK THAT THE PROGRAMMING BOX / HANDY TERMINAL AND TOOLS ARE IN THEIR SPECIFIED LOCATIONS.
- CHECK THAT THE ALARM OR ERROR LAMPS ON THE ROBOT AND PERIPHERAL EQUIPMENT ARE NOT LIT OR FLASHING.

2. During automatic operation and when errors occur

After automatic operation starts, check the operation status and the signal tower to ensure that the robot is in automatic operation.



DANGER

NEVER ENTER THE SAFETY ENCLOSURE DURING AUTOMATIC OPERATION.



WARNING

- IF AN ERROR OCCURS IN THE ROBOT OR PERIPHERAL EQUIPMENT, OBSERVE THE FOLLOWING PROCEDURE BEFORE ENTERING THE SAFETY ENCLOSURE.
- 1) PRESS THE EMERGENCY STOP BUTTON TO SET THE ROBOT TO EMERGENCY STOP.
 - 2) PLACE A SIGN ON THE START SWITCH, INDICATING THAT THE ROBOT IS BEING INSPECTED IN ORDER TO KEEP OTHER PERSONS FROM RESTARTING THE ROBOT.

4.5.3 Precautions during operation

1. When the robot is damaged or an abnormal condition occurs



WARNING

- IF UNUSUAL ODORS, NOISE OR SMOKE OCCUR DURING OPERATION, IMMEDIATELY TURN OFF POWER TO PREVENT POSSIBLE ELECTRICAL SHOCK, FIRE OR BREAKDOWN. STOP USING THE ROBOT AND CONTACT YOUR DISTRIBUTOR.
- IF ANY OF THE FOLLOWING DAMAGE OR ABNORMAL CONDITIONS OCCURS THE ROBOT, THEN CONTINUING TO OPERATE THE ROBOT IS DANGEROUS. IMMEDIATELY STOP USING THE ROBOT AND CONTACT YOUR DISTRIBUTOR.

Damage or abnormal condition	Type of danger
Damage to machine harness or robot cable	Electrical shock, robot malfunction
Damage to robot exterior	Damaged parts fly off during robot operation
Abnormal robot operation (position deviation, vibration, etc.)	Robot malfunction
Z-axis (vertical axis) or brake malfunction	Loads fall off

2. High temperature hazard



WARNING

- DO NOT TOUCH THE ROBOT CONTROLLER AND ROBOT DURING OPERATION. THE ROBOT CONTROLLER AND ROBOT BODY ARE VERY HOT DURING OPERATION, SO BURNS MAY OCCUR IF THESE SECTIONS ARE TOUCHED.
- THE MOTOR AND SPEED REDUCTION GEAR CASING ARE VERY HOT SHORTLY AFTER OPERATION, SO BURNS MAY OCCUR IF THESE ARE TOUCHED. BEFORE TOUCHING THOSE PARTS FOR INSPECTIONS OR SERVICING, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THEIR TEMPERATURE HAS COOLED.

3. Use caution when releasing the Z-axis (vertical axis) brake



WARNING

- THE VERTICAL AXIS WILL SLIDE DOWNWARD WHEN THE BRAKE IS RELEASED, CAUSING A HAZARDOUS SITUATION.
- PRESS THE EMERGENCY STOP BUTTON AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE RELEASING THE BRAKE.
 - BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND THE INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.

4. Be careful of Z-axis movement when the controller is turned off or emergency stop is triggered (air-driven Z-axis)



WARNING

- THE Z-AXIS STARTS MOVING UPWARD WHEN POWER TO THE CONTROLLER OR PLC IS TURNED OFF, THE PROGRAM IS RESET, EMERGENCY STOP IS TRIGGERED, OR AIR IS SUPPLIED TO THE SOLENOID VALVE FOR THE Z-AXIS AIR CYLINDER.
- DO NOT LET HANDS OR FINGERS GET CAUGHT AND SQUEEZED BY ROBOT PARTS MOVING ALONG THE Z-AXIS.
 - KEEP THE USUAL ROBOT POSITION IN MIND SO AS TO PREVENT THE Z-AXIS FROM HANGING UP OR BINDING ON OBSTACLES DURING RAISING OF THE Z-AXIS EXCEPT IN CASE OF EMERGENCY STOP.

5. Take protective measures when the Z-axis interferes with peripheral equipment (air-driven Z-axis)



WARNING

- WHEN THE Z-AXIS COMES TO A STOP DUE TO OBSTRUCTION FROM PERIPHERAL EQUIPMENT, THE Z-AXIS MAY MOVE SUDDENLY AFTER THE OBSTRUCTION IS REMOVED, CAUSING INJURY SUCH AS PINCHED OR CRUSHED HANDS.
- TURN OFF THE CONTROLLER AND REDUCE THE AIR PRESSURE BEFORE ATTEMPTING TO REMOVE THE OBSTRUCTION.
 - BEFORE REDUCING THE AIR PRESSURE, PLACE A SUPPORT UNDER THE Z-AXIS BECAUSE THE Z-AXIS WILL DROP UNDER ITS OWN WEIGHT.

6. Be careful of Z-axis movement when air supply is stopped (air-driven Z-axis)



WARNING

- THE Z-AXIS WILL SLIDE DOWNWARD WHEN THE AIR PRESSURE TO THE Z-AXIS AIR CYLINDER SOLENOID VALVE IS REDUCED, CREATING A HAZARDOUS SITUATION.
- TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE Z-AXIS BEFORE CUTTING OFF THE AIR SUPPLY.

7. Make correct parameter settings



CAUTION

- The robot must be operated with the correct tolerable moment of inertia and acceleration coefficients that match the manipulator tip mass and moment of inertia. Failure to follow this instruction will lead to a premature end to the drive unit service life, damage to robot parts, or cause residual vibration during positioning.

8. If the X-axis, Y-axis or R-axis rotation angle is small



CAUTION

- If the X-axis, Y-axis or R-axis rotation angle is set smaller than 5 degrees, then it will always move within the same position. This restricted position makes it difficult for an oil film to form on the joint support bearing, and so may possibly damage the bearing. In this type of operation, add a range of motion so that the joint moves through 90 degrees or more, about 5 times a day.

4.6 Inspection and maintenance

Always perform daily and periodic inspections and make a pre-operation check to ensure there are no problems with the robot and related equipment. If a problem or abnormality is found, then promptly repair it or take other measures as necessary.

Keep a record of periodic inspections or repairs and store this record for at least 3 years.

4.6.1 Before inspection and maintenance work

1. Do not attempt any work or operation unless described in this manual.

Never attempt any work or operation unless described in this manual.

If an abnormal condition occurs, please be sure to contact your distributor. Our service personnel will take appropriate action.



WARNING

- NEVER ATTEMPT INSTALLATION, ADJUSTMENT, INSPECTION AND MAINTENANCE UNLESS DESCRIBED IN THIS MANUAL.
- NEVER ATTEMPT ANY REPAIR AND PARTS REPLACEMENT UNLESS DESCRIBED IN THIS MANUAL. THESE TASKS REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS AND MAY ALSO INVOLVE HAZARDS. PLEASE BE SURE TO CONTACT YOUR DISTRIBUTOR FOR ADVICE.

2. Precautions during repair and parts replacement



WARNING

WHEN IT IS NECESSARY TO REPAIR OR REPLACE PARTS OF THE ROBOT OR CONTROLLER, PLEASE BE SURE TO CONTACT YOUR DISTRIBUTOR AND FOLLOW THE INSTRUCTIONS THEY PROVIDE. INSPECTION AND MAINTENANCE OF THE ROBOT OR CONTROLLER BY AN UNSKILLED, UNTRAINED PERSON IS EXTREMELY HAZARDOUS.

Adjustment, maintenance and parts replacement require specialized technical knowledge and skills, and also may involve hazards. These tasks must be performed only by persons who have enough ability and qualifications required by local laws and regulations.



WARNING

ADJUSTMENT AND MAINTENANCE BY REMOVING A COVER REQUIRE SPECIALIZED TECHNICAL KNOWLEDGE AND SKILLS, AND MAY ALSO INVOLVE HAZARDS IF ATTEMPTED BY AN UNSKILLED PERSON. FOR DETAILED INFORMATION, PLEASE CONTACT YOUR DISTRIBUTOR WHERE YOU PURCHASED THE PRODUCT.

3. Shut off all phases of power supply



WARNING

ALWAYS SHUT OFF ALL PHASES OF THE POWER SUPPLY EXTERNALLY BEFORE CLEANING THE ROBOT AND CONTROLLER OR SECURELY TIGHTENING THE TERMINAL SCREWS ETC. FAILURE TO DO THIS MAY CAUSE ELECTRICAL SHOCK OR PRODUCT DAMAGE OR MALFUNCTION.

4. Allow a waiting time after power is shut off (Allow time for temperature and voltage to drop)



WARNING

- WHEN PERFORMING MAINTENANCE OR INSPECTION OF THE ROBOT CONTROLLER UNDER YOUR DISTRIBUTOR'S INSTRUCTIONS, WAIT AT LEAST 30 MINUTES FOR THE RCX SERIES OR 5 MINUTES FOR THE SR1 SERIES AFTER TURNING THE POWER OFF. SOME COMPONENTS IN THE ROBOT CONTROLLER ARE VERY HOT OR STILL RETAIN A HIGH VOLTAGE SHORTLY AFTER OPERATION, SO BURNS OR ELECTRICAL SHOCK MAY OCCUR IF THOSE PARTS ARE TOUCHED.
- THE MOTOR AND SPEED REDUCTION GEAR CASING ARE VERY HOT SHORTLY AFTER OPERATION, SO BURNS MAY OCCUR IF THEY ARE TOUCHED. BEFORE TOUCHING THOSE PARTS FOR INSPECTIONS OR SERVICING, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THE TEMPERATURE HAS COOLED.

5. Precautions during inspection of controller



WARNING

- WHEN YOU NEED TO TOUCH THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER DURING INSPECTION, ALWAYS FIRST TURN OFF THE CONTROLLER POWER SWITCH AND ALSO THE POWER SOURCE IN ORDER TO PREVENT POSSIBLE ELECTRICAL SHOCK.
- DO NOT DISASSEMBLE THE CONTROLLER. NEVER TOUCH ANY INTERNAL PARTS OF THE CONTROLLER. DOING SO MAY CAUSE BREAKDOWN, MALFUNCTION, INJURY, OR FIRE.

4.6.2 Precautions during service work

1. Precautions when removing a motor (Cartesian robots and vertical mount single-axis robots)



WARNING

THE VERTICAL AXIS WILL SLIDE DOWN WHEN THE MOTOR IS REMOVED, CAUSING A HAZARDOUS SITUATION.

- TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE REMOVING THE MOTOR.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BY THE DRIVING UNIT OF THE VERTICAL AXIS OR BETWEEN THE VERTICAL AXIS AND THE INSTALLATION BASE.

2. Be careful when removing the Z-axis motor (SCARA robots)



WARNING

THE Z-AXIS WILL SLIDE DOWNWARD WHEN THE Z-AXIS MOTOR IS REMOVED, CAUSING A HAZARDOUS SITUATION.

- TURN OFF THE CONTROLLER AND PLACE A SUPPORT UNDER THE Z-AXIS BEFORE REMOVING THE Z-AXIS MOTOR.
- BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BY THE DRIVING UNIT OF THE Z-AXIS OR BETWEEN THE Z-AXIS DRIVE UNIT AND THE INSTALLATION BASE.

3. Do not remove the Z-axis upper limit mechanical stopper



CAUTION

Warning label 4 is attached to each SCARA robot. (For details on warning labels, see "3. Warning labels" in "Safety instructions.")

Removing the upper limit mechanical stopper installed to the Z-axis spline or shifting its position will damage the Z-axis ball screw. Never attempt to remove it.

4. Use caution when handling a robot that contains powerful magnets



WARNING

POWERFUL MAGNETS ARE INSTALLED INSIDE THE ROBOT. DO NOT DISASSEMBLE THE ROBOT SINCE THIS MAY CAUSE INJURY. DEVICES THAT MAY MALFUNCTION DUE TO MAGNETIC FIELDS MUST BE KEPT AWAY FROM THIS ROBOT.

5. Use the following caution items when disassembling or replacing the pneumatic equipment.



WARNING

AIR OR PARTS MAY FLY OUTWARD IF PNEUMATIC EQUIPMENT IS DISASSEMBLED OR PARTS REPLACED WHILE AIR IS STILL SUPPLIED.

- DO SERVICE WORK AFTER TURNING OFF THE CONTROLLER, REDUCING THE AIR PRESSURE, AND EXHAUSTING THE RESIDUAL AIR FROM THE PNEUMATIC EQUIPMENT.
- BEFORE REDUCING THE AIR PRESSURE, PLACE A SUPPORT STAND UNDER THE Z-AXIS (2-AXIS ROBOTS WITH AIR DRIVEN Z-AXIS) SINCE IT WILL DROP UNDER ITS OWN WEIGHT.

6. Use caution to avoid contact with the controller cooling fan



WARNING

- TOUCHING THE ROTATING FAN MAY CAUSE INJURY.
- IF REMOVING THE FAN COVER, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THE FAN HAS STOPPED.

7. Precautions for robot controllers



CAUTION

- Back up the robot controller internal data on an external storage device. The robot controller internal data (programs, point data, etc.) may be lost or deleted for unexpected reasons. Always make a backup of this data.
- Do not use thinner, benzene, or alcohol to wipe off the surface of the programming box. The surface sheet may be damaged or printed letters or marks erased. Use a soft, dry cloth and gently wipe the surface.
- Do not use a hard or pointed object to press the keys on the programming box. Malfunction or breakdown may result if the keys are damaged. Use your fingers to operate the keys.
- Do not insert any SD memory card other than specified into the SD memory card slot in the programming box. Malfunction or breakdown may result if the wrong memory card is inserted.

4.7 Disposal

When disposing of robots and related items, handle them carefully as industrial wastes. Use the correct disposal method in compliance with your local regulations, or entrust disposal to a licensed industrial waste disposal company.

1. Disposal of lithium batteries

When disposing of lithium batteries, use the correct disposal method in compliance with your local regulations, or entrust disposal to a licensed industrial waste disposal company. We do not collect and dispose of the used batteries.

2. Disposal of packing boxes and materials

When disposing of packing boxes and materials, use the correct disposal method in compliance with your local regulations. We do not collect and dispose of the used packing boxes and materials.

3. Strong magnet



WARNING

STRONG MAGNETS ARE INSTALLED IN THE ROBOT. BE CAREFUL WHEN DISPOSING OF THE ROBOT.

5. Emergency action when a person is caught by robot

If a person should get caught between the robot and a mechanical part such as the installation base, then release the axis.

■ Emergency action

Release the axis while referring to the following section in the manual for the robot controller.

Controller	Refer to:
RCX240	Section 8, "Freeing a person caught by the robot" in Chapter 1



NOTE

Make a printout of the relevant page in the manual and post it a conspicuous location near the controller.

6. Using the robot safely

6.1 Robot safety functions

Safety functions for YAMAHA robots are described below.

1. Overload detection

This function detects an overload applied to the motor and shuts off the servo power.

If an overload error occurs, take the following measures to avoid such errors:

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

2. Overheat detection

This function detects an abnormal temperature rise in the driver inside the controller and shuts off the servo power.

If an overheat error occurs, take the following measures to avoid the error:

1. Insert a timer in the program.
2. Reduce the acceleration coefficient.

3. Soft limits

Soft limits can be set on each axis to limit the working envelope in manual operation after return-to-origin and during automatic operation. The working envelope is the area limited by soft limits.



WARNING

SOFT LIMITS MUST BE SET WITHIN THE MOVEMENT RANGE (MECHANICAL STOPPER). IF THE SOFT LIMIT IS SET OUTSIDE THE MOVEMENT RANGE, THEN THE ROBOT AXIS MAY COLLIDE WITH THE MECHANICAL STOPPER AT HIGH SPEED, CAUSING THE OBJECT GRIPPED BY THE END EFFECTOR TO FLY OUTWARD OR DROP, AND THE ROBOT TO MALFUNCTION.

4. Mechanical stoppers

If the servo power is shut off by emergency stop operation or safety function while the robot is moving, then these mechanical stoppers prevent the axis from exceeding the movement range. No mechanical stopper is provided on the rotational axis. The movement range is the area limited by the mechanical stoppers.

- The X and Y axes have mechanical stoppers that are installed at both ends of the maximum movement range. Some robot models have a standard feature that allows changing the mechanical stopper positions. On some other models, the mechanical stopper positions can also be changed by using option parts.
- The Z-axis has a mechanical stopper at the upper end and lower end. The stopper positions can be changed by using option parts.
- No mechanical stopper is provided on the R-axis.



WARNING

AXIS MOVEMENT DOES NOT STOP IMMEDIATELY AFTER THE SERVO POWER SUPPLY IS SHUT OFF BY EMERGENCY STOP OR OTHER SAFETY FUNCTIONS.

5. Z-axis (vertical axis) brake

An electromagnetic brake is installed on the Z-axis to prevent the Z-axis from sliding downward when servo power is OFF. This brake is working when the controller is OFF or the Z-axis servo power is OFF even when the controller is ON. The Z-axis brake can be released by the programming unit / handy terminal or by a command in the program when the controller is ON.



WARNING

THE VERTICAL AXIS WILL SLIDE DOWNWARD WHEN THE Z-AXIS BRAKE IS RELEASED, CREATING A HAZARDOUS SITUATION.

- **PRESS THE EMERGENCY STOP BUTTON AND PLACE A SUPPORT UNDER THE VERTICAL AXIS BEFORE RELEASING THE BRAKE.**
- **BE CAREFUL NOT TO LET YOUR BODY GET CAUGHT BETWEEN THE VERTICAL AXIS AND INSTALLATION BASE WHEN RELEASING THE BRAKE TO PERFORM DIRECT TEACH.**

6.2 Special training for industrial robot operation

Operators or persons who handle the robot for tasks such as for teaching, programming, movement checks, inspections, adjustments, and repairs must receive appropriate training and also have the skills needed to perform the job correctly and safely. They must also read the manual carefully to understand its contents before attempting the robot operation or maintenance.

Tasks related to industrial robots (teaching, programming, movement check, inspection, adjustment, repair, etc.) must be performed by qualified persons who meet requirements established by local regulations and safety standards for industrial robots.

This manual does not serve as a guarantee of any industrial property rights or any other rights and does not grant a license in any form. Please acknowledge that we bear no liability whatsoever for any problems involving industrial property rights which may arise from the contents of this manual.

Revision record

Manual version	Issue date	Description
Ver. 1.00	May 2012	First edition
Ver. 1.01	Jun. 2012	Description of "Emergency action when a person is caught by robot" was added, the work sequence for working within the safety enclosure changed, typing errors corrected, etc.

YAMAHA Safety Instructions

Jun. 2012

Ver. 1.01

This manual is based on Ver. 1.01 of Japanese manual.

YAMAHA MOTOR CO., LTD. IM Operations

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Warranty

For information on the warranty period and terms, please contact our distributor where you purchased the product.

■ This warranty does not cover any failure caused by:

1. Installation, wiring, connection to other control devices, operating methods, inspection or maintenance that does not comply with industry standards or instructions specified in the YAMAHA manual;
2. Usage that exceeded the specifications or standard performance shown in the YAMAHA manual;
3. Product usage other than intended by YAMAHA;
4. Storage, operating conditions and utilities that are outside the range specified in the manual;
5. Damage due to improper shipping or shipping methods;
6. Accident or collision damage;
7. Installation of other than genuine YAMAHA parts and/or accessories;
8. Modification to original parts or modifications not conforming to standard specifications designated by YAMAHA, including customizing performed by YAMAHA in compliance with distributor or customer requests;
9. Pollution, salt damage, condensation;
10. Fires or natural disasters such as earthquakes, tsunamis, lightning strikes, wind and flood damage, etc;
11. Breakdown due to causes other than the above that are not the fault or responsibility of YAMAHA;

■ The following cases are not covered under the warranty:

1. Products whose serial number or production date (month & year) cannot be verified.
2. Changes in software or internal data such as programs or points that were created or changed by the customer.
3. Products whose trouble cannot be reproduced or identified by YAMAHA.
4. Products utilized, for example, in radiological equipment, biological test equipment applications or for other purposes whose warranty repairs are judged as hazardous by YAMAHA.

THE WARRANTY STATED HEREIN PROVIDED BY YAMAHA ONLY COVERS DEFECTS IN PRODUCTS AND PARTS SOLD BY YAMAHA TO DISTRIBUTORS UNDER THIS AGREEMENT. ANY AND ALL OTHER WARRANTIES OR LIABILITIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY EXPRESSLY DISCLAIMED BY YAMAHA. MOREOVER, YAMAHA SHALL NOT BE HELD RESPONSIBLE FOR CONSEQUENTIAL OR INDIRECT DAMAGES IN ANY MANNER RELATING TO THE PRODUCT.

Chapter 1

Overview

Contents

1. Overview

1-1

1. Overview

Before beginning the work, thoroughly read the safety precautions described below and the Safety Instructions to strictly observe the instructions.



WARNING

THE ADJUSTMENT AND MAINTENANCE WORK WITH THE COVER REMOVED NEEDS THE SPECIAL KNOWLEDGE AND SKILL. IF UNSKILLED WORK PERSON PERFORMS SUCH WORK, THIS MAY INVOLVE RISK. ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE ADJUSTMENT AND MAINTENANCE WORK WHILE REFERRING TO THIS MANUAL. FOR DETAILS, CONTACT YOUR DISTRIBUTOR.



WARNING

- ALWAYS TURN OFF THE CONTROLLER BEFORE BEGINNING WORK. SERIOUS ACCIDENTS MIGHT OCCUR IF THE ROBOT STARTS TO OPERATE DURING WORK.
- NEVER ATTEMPT TO PERFORM WORK OTHER THAN THOSE DESCRIBED IN THIS MANUAL.
- PLACE A CONSPICUOUS SIGN INDICATING THE ROBOT IS BEING ADJUSTED, TO PREVENT OTHERS FROM TOUCHING THE CONTROLLER SWITCH, PROGRAMMING BOX OR OPERATION PANEL.
- IF A SAFETY ENCLOSURE HAS NOT YET BEEN PROVIDED RIGHT AFTER INSTALLATION OF THE ROBOT, ROPE OFF OR CHAIN OFF THE MOVEMENT AREA AROUND THE MANIPULATOR IN PLACE OF A SAFETY ENCLOSURE, AND OBSERVE THE FOLLOWING POINTS.
 1. USE STABLE POSTS WHICH WILL NOT FALL OVER EASILY.
 2. THE ROPE OR CHAIN SHOULD BE EASILY VISIBLE BY EVERYONE AROUND THE ROBOT.
 3. PLACE A CONSPICUOUS SIGN PROHIBITING THE OPERATOR OR OTHER PERSONNEL FROM ENTERING THE MOVEMENT AREA OF THE MANIPULATOR.
- TO CHECK THE OPERATION AFTER THE ADJUSTMENT HAS BEEN MADE, SEE "4.5.1 TRIAL OPERATION" IN THE SAFETY INSTRUCTIONS.

Chapter 2

Periodic inspection

Contents

1. Before beginning work	2-1
2. Periodic inspection	2-2
2.1 Daily inspection	2-2
2.2 Three-month inspection	2-3
2.3 Six-month inspection	2-5
2.4 Three-year inspection	2-6
3. Applying the grease	2-7
3.1 T4L/T4LH/T5L/T5LH/T6L	2-8
3.2 T9/T9H/F10/F14/F14H/F17/F17L/F20/F20N	2-9
3.3 F8/F8L/F8LH	2-10
3.4 N15/N15D/N18/N18D	2-11
3.5 B10/B14/B14H	2-12

1. Before beginning work

Periodic inspection and maintenance are essential to ensure safe and efficient operation of YAMAHA robots. This Chapter describes the periodic inspection of the FLIP-X series. Before beginning the work, thoroughly read the safety precautions described below and the Safety Instructions to strictly observe the instructions.

■ Safety precautions



DANGER

IF THE INSPECTION OR MAINTENANCE PROCEDURE CALLS FOR OPERATION OF THE ROBOT, STAY OUT OF THE WORKING AREA OF THE ROBOT DURING OPERATION. KEEP WATCHING THE ROBOT MOVEMENT AND SURROUNDING AREA SO THAT THE OPERATOR CAN PRESS THE EMERGENCY STOP BUTTON IF ANY DANGER OCCURS.



WARNING

- THE ADJUSTMENT AND MAINTENANCE WORK WITH THE COVER REMOVED NEEDS THE SPECIAL KNOWLEDGE AND SKILL. IF UNSKILLED WORK PERSON PERFORMS SUCH WORK, THIS MAY INVOLVE RISK. ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE ADJUSTMENT AND MAINTENANCE WORK WHILE REFERRING TO THIS MANUAL.
- WHEN THE ROBOT DOES NOT NEED TO BE OPERATED DURING ADJUSTMENT OR MAINTENANCE, ALWAYS TURN OFF THE CONTROLLER AND THE EXTERNAL SWITCH BOARD.
- WHEN YOU NEED TO TOUCH THE TERMINALS OR CONNECTORS ON THE OUTSIDE OF THE CONTROLLER DURING INSPECTION, ALWAYS FIRST TURN OFF THE CONTROLLER POWER SWITCH AND ALSO THE POWER SOURCE IN ORDER TO PREVENT POSSIBLE ELECTRICAL SHOCK.
- NEVER TOUCH INTERNAL PARTS OF THE CONTROLLER.
- WHEN ONLY MAKING ELECTRICAL INSPECTIONS AND REQUIRING NO MECHANICAL MOVEMENT OF THE ROBOT, KEEP THE EMERGENCY STOP BUTTON PRESSED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.
- BE SURE TO USE THE LUBRICANT SPECIFIED BY YOUR DISTRIBUTOR.
- BE SURE TO USE THE PARTS SPECIFIED BY YOUR DISTRIBUTOR WHEN REPLACING PARTS.
TAKE SUFFICIENT CARE NOT TO ALLOW ANY FOREIGN MATTER TO CONTAMINATE THEM DURING ADJUSTMENT, PARTS REPLACEMENT OR REASSEMBLY.
- DO NOT MODIFY ANY PARTS ON THE ROBOT OR CONTROLLER. MODIFICATION MAY RESULT IN UNSATISFACTORY SPECIFICATIONS OR THREATEN OPERATOR SAFETY.
- WHEN ADJUSTMENT OR MAINTENANCE IS COMPLETE, RETIGHTEN THE BOLTS AND SCREWS SECURELY.
- PLACE A SIGN INDICATING THE ROBOT IS BEING ADJUSTED OR INSPECTED TO KEEP OTHERS FROM OPERATING THE CONTROLLER POWER SWITCH, PROGRAMMING BOX, HANDY TERMINAL, OR OPERATION PANEL. WHEN NECESSARY, INSTALL AN APPROPRIATE SWITCH KEY LOCK MECHANISM OR ARRANGE A WATCHER.



CAUTION

- Only qualified engineers who have the skill and license in accordance with the laws and regulations in each country are allowed to carry out the periodic inspection.
- Never attempt to perform inspection, adjustment, repair, or part replacement work of the robot and controller other than those described in this manual. Such work requires special knowledge and may involve risk.
- Before starting each adjustment work, thoroughly read this Chapter to fully understand its contents.
- If a safety enclosure has not yet been provided right after installation of the robot, rope off or chain off the movement area around the manipulator in place of a safety enclosure, and observe the following points.
 1. Use stable posts which will not fall over easily.
 2. The rope or chain should be easily visible by everyone around the robot.
 3. Place a conspicuous sign prohibiting the operator or other personnel from entering the movement area of the manipulator.
- To check the operation after the adjustment has been made, see "4.5.1 Trial operation" in the Safety Instructions.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.
- For details about cautions on controller, see the User's Manual for controller.

2. Periodic inspection

2.1 Daily inspection

The following is an inspection list that must be performed every day before and after operating the robot.

■ Inspection to be performed with the controller turned off

Step 1 Turn off the controller.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being inspected, to keep others from operating the controller switch.

Step 3 Perform the daily inspection.

Enter the safety enclosure and check the following points.

Checkpoints	Procedure	Remarks
Cables	Check for damage, dent and excessively tight bends.	- Make the adjustment so that any stress is not applied to the cables. - If any damage is found, replace the defective cable according to the conditions. (See also "2.2 Robot cables" in Chapter 5 of the separate Installation Manual.)
Shutter	- Check for scratches, dents, and excessively tight bends. - Check for flow-up (clearance). - Check the shutter top surface for contamination (*1).	See "5. Adjusting the shutter looseness" in Chapter 3. When the shutter replacement is needed, see "1. Replacing the shutter" in Chapter 4.
Ball screw, bearing	Check for unusual vibration or noise.	If any trouble is found, contact your distributor.
Motor	Check for unusual vibration and noise, and for abnormal temperature rise.	Check with the load factor monitor that the load factor is 100% or less. (*2)

*1: According to the robot working conditions, stripe marks caused by contamination may be produced on the shutter top surface close to the stop point. If this occurs, clean the shutter top surface with a cloth rag moistened with alcohol cleaning agent. If this trouble occurs frequently, contact your distributor.

*2: Some robot controller models cannot monitor the load factor.

■ Inspection to be performed with the controller turned on



WARNING

THE ROBOT CONTROLLER MUST BE INSTALLED OUTSIDE THE SAFETY ENCLOSURE, TO PREVENT A HAZARDOUS SITUATION IN WHICH YOU OR ANYONE ENTER THE SAFETY ENCLOSURE TO INSPECT THE CONTROLLER WHILE IT IS TURNED ON.

Step 1 Turn on the controller.

Check that no one is inside the safety enclosure, and then turn on the controller.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being inspected, to keep others from operating the controller, programming box or operation panel.

Step 3 Perform the daily inspection.

Check the following points from outside the safety enclosure.

Checkpoint	Procedure	Remarks
Safety enclosure	Check if the safety enclosure is in place. Check if emergency stop is triggered when the door is opened. Check if warning labels are affixed at the entrance and clearly visible.	
Emergency stop device	Press the emergency stop button to check if it works.	
Robot movement	Check for abnormal movement and excessive vibration and noise.	If any abnormal operation is found, contact your distributor.
Z-axis brake operation (*1)	Check if the brake works to stop the Z-axis from dropping more than 3mm from the stationary point.	If any abnormal operation is found, contact your distributor.

*1: Visually check the Z-axis movement when you press the emergency stop button from outside the safety enclosure and also when you turn off the controller.

■ Adjustment and parts replacement



WARNING

- AFTER INSPECTION, IF YOU NOTICE ANY ADJUSTMENT OR PARTS REPLACEMENT IS NEEDED, FIRST TURN OFF THE CONTROLLER AND THEN ENTER THE SAFETY ENCLOSURE TO PERFORM THE NECESSARY WORK.
- AFTER THE ADJUSTMENT OR REPLACEMENT WORK HAS BEEN COMPLETED, INSPECT THE CHECKPOINTS STATED IN "DAILY INSPECTION" IN THIS SECTION.
- IF THE REPAIR OR PART REPLACEMENT OF THE ROBOT OR CONTROLLER IS REQUIRED, CONTACT YOUR DISTRIBUTOR. SUCH WORK NEEDS THE SPECIAL KNOWLEDGE AND SKILL. SO, ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPAIR OR PART REPLACEMENT WORK OF THE ROBOT OR CONTROLLER.

2.2 Three-month inspection

Take the following precautions when performing 3-month inspection.



WARNING

WHEN THE BRAKE OF THE VERTICAL AXIS IS RELEASED, THE SLIDER AXIS MAY DROP, LEADING TO HAZARDOUS SITUATION. WHEN APPLYING THE GREASE TO THE VERTICAL AXIS PARTS, DO NOT RELEASE THE BRAKE.

■ Inspection to be performed with the controller turned off

Step 1 Turn off the controller.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being inspected, to keep others from operating the controller switch.

Step 3 Perform the daily inspection.

Enter the safety enclosure and check the following points.

Checkpoint	Procedure	Remarks
Manipulator bolts and screws (Only for major bolts and screws exposed externally)	Check for looseness and tighten if necessary. (*1)	
Controller	Check for looseness at each terminal and connector on the panel.	
Ball screw, Linear guide	• Check for dirt or grime. If dirt or grime is found, clean the part. Apply grease after cleaning. • Apply grease if the items checked are dry or do not have enough grease. Recommended grease : Alvania grease S2 (Showa Shell) : Alvania No.2 (Showa Shell) : Daphne Eponex No. 2 (Idemitsu)	See "3. Applying the grease" in this Chapter.
Shutter	• Check for looseness. • Check for flow-up (clearance).	See "5. Adjusting shutter looseness" in Chapter 3.

*1: Bolt tightening torque

Bolt size	Tightening torque (kgfcm)	Tightening torque (Nm)
M3 button head bolt	14	1.4
M3	20	2.0
M4	46	4.5
M5	92	9.0
M6	156	15.3
M8	380	37
M10	720	71
M12	1310	128



CAUTION

If the grease recommended by YAMAHA is not used, this may cause the service life of the ball screw or linear guide to shorten.

■ Inspection to be performed with the controller turned on



WARNING

THE ROBOT CONTROLLER MUST BE INSTALLED OUTSIDE THE SAFETY ENCLOSURE, TO PREVENT A HAZARDOUS SITUATION IN WHICH YOU OR ANYONE ENTER THE SAFETY ENCLOSURE TO INSPECT THE CONTROLLER WHILE IT IS TURNED ON.



WARNING

- BODILY INJURY MAY OCCUR FROM COMING INTO CONTACT WITH THE FAN WHILE IT IS ROTATING.
- WHEN REMOVING THE FAN COVER FOR INSPECTION, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THE FAN HAS STOPPED.

Step 1 Turn on the controller.

Check that no one is inside the safety enclosure, and then turn on the controller.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being inspected, to keep others from operating the controller, programming box or operation panel.

Step 3 Perform the daily inspection.

Check the following points from outside the safety enclosure.

Checkpoint	Procedure
Cooling fan at rear of controller	• Check if the fan rotates normally. • Check if objects blocking the fan are located and remove if any are found. • Check for abnormal noise from the rotating fan. If abnormal noise is heard, visually check and remove the cause. If no cause is found, contact your distributor . • Check for dust on the fan cover. Remove and clean if necessary.

■ Adjustment and parts replacement



WARNING

- AFTER INSPECTION, IF YOU NOTICE ANY ADJUSTMENT OR PARTS REPLACEMENT IS NEEDED, FIRST TURN OFF THE CONTROLLER AND THEN ENTER THE SAFETY ENCLOSURE TO PERFORM THE NECESSARY WORK.
- AFTER THE ADJUSTMENT OR REPLACEMENT WORK HAS BEEN COMPLETED, INSPECT THE CHECKPOINTS STATED IN "DAILY INSPECTION" IN THIS SECTION.
- IF THE REPAIR OR PART REPLACEMENT OF THE ROBOT OR CONTROLLER IS REQUIRED, CONTACT YOUR DISTRIBUTOR. SUCH WORK NEEDS THE SPECIAL KNOWLEDGE AND SKILL. SO, ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPAIR OR PART REPLACEMENT WORK OF THE ROBOT OR CONTROLLER.

2.3 Six-month inspection

Take the following precautions when performing 6-month inspection.



WARNING

WHEN THE BRAKE OF THE VERTICAL AXIS IS RELEASED, THE SLIDER AXIS MAY DROP, LEADING TO HAZARDOUS SITUATION. WHEN APPLYING THE GREASE TO THE VERTICAL AXIS PARTS, DO NOT RELEASE THE BRAKE.

■ Inspection to be performed with the controller turned off

Step 1 Turn off the controller.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign showing that the robot is being inspected, to keep others from operating the controller switch.

Step 3 Perform the daily inspection.

Enter the safety enclosure and check the following points.

Checkpoint	Procedure	Remarks
Major bolts and screws on exterior of robot main unit	Check for looseness and tighten if necessary. (*1)	
Ball screw and linear guide	- Check for looseness in the ball screw and linear guide. Tighten if necessary. - Check for vibration during operation. Tighten drive section, and X and Y axis installation bolts if necessary. - Check for wear and backlash. If any abnormality is found, contact your distributor.	If problem is not solved or wear and backlash are found, please contact your distributor.
Controller	- Check for loose terminals. - Check for loose connectors.	
Application of grease to ball screw/nut and linear guide	Apply Alvania No. 2 (Showa Shell), Alvania S2 (Showa Shell), or Daphne Eponex No. 2 (Idemitsu) to the ball screw nut and linear guide every 6 months.	See "4. Applying the grease" in this Chapter.
Belt	- Check the timing belt for fault (scratch or crack). - Check the tension of the timing belt.	See Chapter 3, Adjustment.
Slider	Check for unusual wear or damage.	- If the friction is the cause of the trouble, make the adjustment so that the interference between the mating part and slider is eliminated. - If the slider is broken, contact your distributor.
Insert	- Check that the positioning is correct during operation. - Check for unusual noise during operation.	See "3. Replacing the insert" in Chapter 4.

*1: Bolt tightening torque

Bolt size	Tightening torque (kgfcm)	Tightening torque (Nm)
M3 button head bolt	14	1.4
M3	20	2.0
M4	46	4.5
M5	92	9.0
M6	156	15.3
M8	380	37
M10	720	71
M12	1310	128



CAUTION

If the grease recommended by YAMAHA is not used, this may cause the service life of the ball screw or linear guide to shorten.

■ Inspection to be performed with the controller turned on



WARNING

THE ROBOT CONTROLLER MUST BE INSTALLED OUTSIDE THE SAFETY ENCLOSURE, TO PREVENT A HAZARDOUS SITUATION IN WHICH YOU OR ANYONE ENTER THE SAFETY ENCLOSURE TO INSPECT THE CONTROLLER WHILE IT IS TURNED ON.



WARNING

- BODILY INJURY MAY OCCUR FROM COMING INTO CONTACT WITH THE FAN WHILE IT IS ROTATING.
- WHEN REMOVING THE FAN COVER FOR INSPECTION, FIRST TURN OFF THE CONTROLLER AND MAKE SURE THE FAN HAS STOPPED.

Step 1 Turn on the controller.

Check that no one is inside the safety enclosure, and then turn on the controller.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being inspected, to keep others from operating the controller, programming box or operation panel.

Step 3 Perform the daily inspection.

Check the following points from outside the safety enclosure.

Checkpoint	Procedure
Cooling fan at rear of controller	• Check if the fan rotates normally. • Check if objects blocking the fan are located and remove if any are found. • Check for abnormal noise from the rotating fan. If abnormal noise is heard, visually check and remove the cause. If no cause is found, contact your distributor . • Check for dust on the fan cover. Remove and clean if necessary.

■ Adjustment and parts replacement



WARNING

- AFTER INSPECTION, IF YOU NOTICE ANY ADJUSTMENT OR PARTS REPLACEMENT IS NEEDED, FIRST TURN OFF THE CONTROLLER AND THEN ENTER THE SAFETY ENCLOSURE TO PERFORM THE NECESSARY WORK.
- AFTER THE ADJUSTMENT OR REPLACEMENT WORK HAS BEEN COMPLETED, INSPECT THE CHECKPOINTS STATED IN "DAILY INSPECTION" IN THIS SECTION.
- IF THE REPAIR OR PART REPLACEMENT OF THE ROBOT OR CONTROLLER IS REQUIRED, CONTACT YOUR DISTRIBUTOR. SUCH WORK NEEDS THE SPECIAL KNOWLEDGE AND SKILL. SO, ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPAIR OR PART REPLACEMENT WORK OF THE ROBOT OR CONTROLLER.

2.4 Three-year inspection

Inspect the following points once every three years, and contact us if any problem is found.

Set an earlier inspection interval if parts are subject to long-term or frequent usage.

Checkpoint	Procedure	Remarks
Ball screw nut sections and linear guides	Check for wear and looseness in the ball screw, nut and linear guide.	If any abnormality is found, contact your distributor.

3. Applying the grease

To apply the grease in accordance with the periodic inspection, follow the steps below. Before applying the grease, thoroughly read the cautions stated in the Safety Guide and "Before beginning work" in this Chapter to strictly observe the instructions.

When applying grease to the ball screws and linear guide, take the following precautions.



WARNING

PRECAUTIONS WHEN HANDLING GREASE:

- INFLAMMATION MAY OCCUR IF THIS GETS IN THE EYES.
BEFORE HANDLING THE GREASE, WEAR YOUR SAFETY GOGGLES TO ENSURE THE GREASE WILL NOT COME IN CONTACT WITH THE EYES.
- INFLAMMATION MAY OCCUR IF THE GREASE COMES INTO CONTACT WITH SKIN. BE SURE TO WEAR PROTECTIVE GLOVES TO PREVENT CONTACT WITH SKIN.
- DO NOT TAKE ORALLY OR EAT. (EATING WILL CAUSE DIARRHEA AND VOMITING.)
- HANDS AND FINGERS MIGHT BE CUT WHEN OPENING THE CONTAINER, SO USE PROTECTIVE GLOVES.
- KEEP OUT OF THE REACH OF CHILDREN.
- DO NOT HEAT THE GREASE OR PLACE NEAR AN OPEN FLAME SINCE THIS COULD LEAD TO SPARKS AND FIRES.

EMERGENCY TREATMENT:

- IF THIS GREASE GETS IN THE EYES, WASH LIBERALLY WITH PURE WATER FOR ABOUT 15 MINUTES AND CONSULT A PHYSICIAN FOR TREATMENT.
- IF THIS GREASE COMES IN CONTACT WITH THE SKIN, WASH AWAY COMPLETELY WITH SOAP AND WATER.
- IF TAKEN INTERNALLY, DO NOT INDUCE VOMITING BUT PROMPTLY CONSULT A PHYSICIAN FOR TREATMENT.



WARNING

DISPOSING OF GREASE AND THE CONTAINER:

- PROPER DISPOSAL IS COMPULSORY UNDER FEDERAL, STATE AND LOCAL REGULATIONS. TAKE APPROPRIATE MEASURES IN COMPLIANCE WITH LEGAL REGULATIONS.
- DO NOT PRESSURIZE THE EMPTY CONTAINER. PRESSURIZING MAY CAUSE THE CONTAINER TO RUPTURE.
- DO NOT ATTEMPT TO WELD, HEAT UP, DRILL HOLES OR CUT THIS CONTAINER. THIS MIGHT CAUSE THE CONTAINER TO EXPLODE AND THE REMAINING MATERIALS INSIDE IT TO IGNITE.



WARNING

WHEN THE BRAKE OF THE VERTICAL AXIS IS RELEASED, THE SLIDER AXIS MAY DROP, LEADING TO HAZARDOUS SITUATION. WHEN APPLYING THE GREASE TO THE VERTICAL AXIS PARTS, DO NOT RELEASE THE BRAKE.



CAUTION

Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.

3.1 T4L/T4LH/T5L/T5LH/T6L

Prepare appropriate Phillips screwdriver and brush (for grease application).

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the two screws from one side.

Remove the two screws from one side of the screws securing both ends of the shutter.



CAUTION

At this time, do not remove the cover completely.

Step 5 Turn over the shutter from the side where the screws have been removed.



CAUTION

When turning over the shutter, carefully handle it so that the shutter surface is not scratched.

Step 6 Wipe off the contaminated grease.

First, wipe off the contaminated grease with a clean cloth rag.

Step 7 Apply the grease.

Apply an adequate amount of grease to the ball screw or linear guide so that it does not scatter surroundings.



CAUTION

For the T4L/T4LH robot, the brush insertion portion is narrow. So, apply the grease with a small brush.

23301-A1-00

Step 8 Spread the grease.

Move the slider back and forth to spread the grease.



CAUTION

Do not put your finger in the slider movement range to prevent your finger from being caught in if the slider is moved by hand accidentally.

Step 9 Reattach the shutter to its original position.



NOTE

For details about how to adjust the shutter, see "4. Adjusting shutter looseness" in this Chapter.

Step 7 Applying the grease.



Applying grease to the ball screw



Applying grease to the linear guide

3.2 T9/T9H/F10/F14/F14H/F17/F17L/F20/F20N

Prepare the tools necessary for the replacement work.

- Phillips screwdriver
- Grease gun (recommended grease gun: THK's MG70, nozzle shape: N type)
- Brush (for grease application)

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Wipe off the contaminated grease.

First, wipe off the contaminated grease with a clean cloth rag wound on the stick.



CAUTION

Do not put your finger in the slider movement range to prevent your finger from being caught in if the slider is moved by hand accidentally.

Apply grease by either of the following methods.

■ Linear guide

Step 5 Apply the grease.

Use the grease gun to apply the grease to the grease nipple of the linear guide through the clearance between the upper cover and frame.

23301-A4-00

▶ **Step 5** Applying the grease to the linear guide.



■ Ball screw

Step 5 Apply the grease.

Apply the grease to the screw thread roots thinly and uniformly with the brush. Move the slider back and forth to spread the grease.

23302-A4-00

▶ **Step 5** Applying the grease to the ball screw.



Step 6 Wipe off the excess grease.

Finally, wipe off the excess grease with a clean cloth rag.



CAUTION

When the robot is mounted vertically, go outside the safety enclosure once. Check that no one is inside the safety enclosure, and then turn on the controller power. After that, slowly move the slider two or three times in the manual mode and turn off the controller power. Enter the safety enclosure again and continue the work.

3.3 F8/F8L/F8LH

Prepare the tools necessary for the replacement work.

- Phillips screwdriver
- Grease gun (recommended grease gun: THK's MG70, nozzle shape: H type)
- Brush (for grease application)

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Wipe off the contaminated grease.

First, wipe off the contaminated grease with a clean cloth rag wound on the stick.



CAUTION

Do not put your finger in the slider movement range to prevent your finger from being caught in if the slider is moved by hand accidentally.

Apply grease by either of the following methods.

■ Linear guide

Step 5 Apply the grease.

When using the grease nipples, apply grease into the two grease nipples on the left and right side of the slider (4 grease nipples for F8LH). Then move the table slider back and forth to help spread the grease around.

23301-A5-00

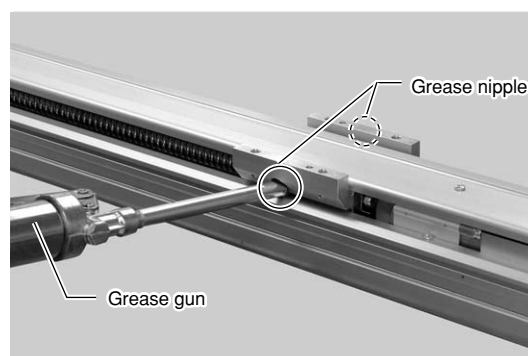
■ Ball screw

Step 5 Apply the grease.

Apply an adequate amount of grease to the ball screw so that it does not scatter surroundings. Move the table slider back and forth to spread the grease.

23302-A5-00

Step 5 Applying the grease to the linear guide.



Step 5 Applying the grease to the ball screw.



3.4 N15/N15D/N18/N18D

Prepare the tools necessary for the replacement work.

- Phillips screwdriver
- Grease gun (recommended grease gun: THK's MG70, nozzle shape: H type)
- Brush (for grease application)

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Wipe off the contaminated grease.

First, wipe off the contaminated grease with a clean cloth rag.



CAUTION

Do not put your finger in the slider movement range to prevent your finger from being caught in if the slider is moved by hand accidentally.

Apply grease by either of the following methods.

■ Linear guide

Step 5 Apply the grease.

When using a grease gun, apply grease into the four grease nipples (two each on both sides of the ball guide bearing). Then move the table slider back and forth to help spread the grease around.

23301-AA-00

► **Step 5** Applying the grease to the linear guide.



■ Ball screw

Step 5 Apply the grease.

Apply an adequate amount of grease to the ball screw so that it does not scatter surroundings. Move the table slider back and forth to spread the grease.

23302-AA-00

► **Step 5** Applying the grease to the ball screw.



3.5 B10/B14/B14H

Apply grease to the linear guide every 3 months.

Prepare the tools necessary for the replacement work.

- Phillips screwdriver
- Grease gun
- Brush (for grease application)

Using the following grease gun and grease will ensure correct refills of grease.

Grease gun model : MG70 (made by THK) or equivalent

Nozzle type : N type (made by THK) or equivalent

Grease : AFB grease (made by THK, 70g cartridge) or equivalent

Step 1 *Turn off the controller power.*

Step 2 *Place a sign indicating the robot is being adjusted.*

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 *Enter the safety enclosure.*

Step 4 *Wipe off the contaminated grease.*

First, wipe off the contaminated grease with a clean cloth rag wound on the stick.



CAUTION

Do not put your finger in the slider movement range to prevent your finger from being caught in if the slider is moved by hand accidentally.

Step 5 *Apply the grease.*

Use the grease gun to apply the grease to the grease nipple of the linear guide through the clearance between the upper cover and frame.

Chapter 3

Adjustment

Contents

1. Adjusting the alignment (B10/B14/B14H)	3-1
2. Adjusting the timing belt tension (B10/B14/B14H)	3-2
2.1 Adjusting the drive belt tension	3-3
2.2 Adjusting the speed reduction belt tension	3-4
3. Adjusting the timing belt tension (F20N)	3-6
3.1 Installing and removing the cover	3-6
3.1.1 Stroke cover	3-6
3.1.2 Belt cover	3-8
3.1.3 Motor cover	3-9
3.2 Adjusting the timing belt tension	3-10
4. Adjusting shutter looseness (T4L/T4LH/T5L/T5LH/T6L)	3-11

1. Adjusting the alignment (B10/B14/B14H)

On robot models having a long stroke, a slider travel guide (U groove) is provided inside the upper cover. The slider must be aligned with this U groove when attaching the upper cover.



WARNING

- BEFORE STARTING THE WORK, BE SURE TO DISCONNECT THE ROBOT FROM THE CONTROLLER OR TURN OFF THE CONTROLLER POWER. IF THE ROBOT OPERATES DURING WORK, THIS MAY CAUSE SERIOUS ACCIDENT.
- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE ADJUSTMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- If the slider and upper cover alignment is poor, the slider may wear out prematurely. Insert the slider into the U groove correctly so that the slider is not worn away or damaged by the edge of the upper cover.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Insert the slider.

Insert the slider into the U-shape groove at the center of the upper cover. At this time, put the upper cover parallel with the axis movement direction.

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Step 5 Secure the upper cover mounting screws temporarily.

Secure the upper cover mounting screws (four screws) temporarily and move the table from the motor side to the end of the anti-motor side.

Step 6 Retighten the screws on the anti-motor side.

Retighten the screws on the anti-motor side and move the table to the motor side again.

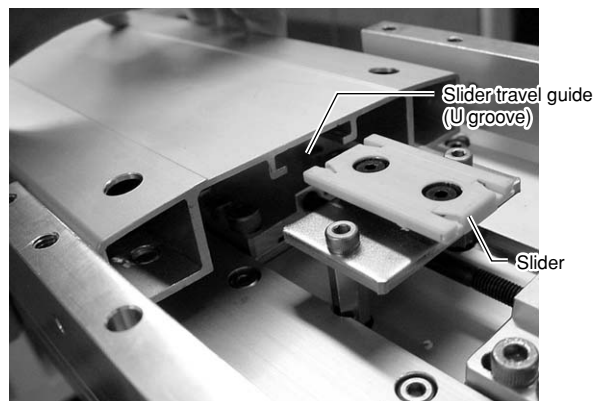
Step 7 Retighten the upper cover mounting screws (two screws) on the motor side.

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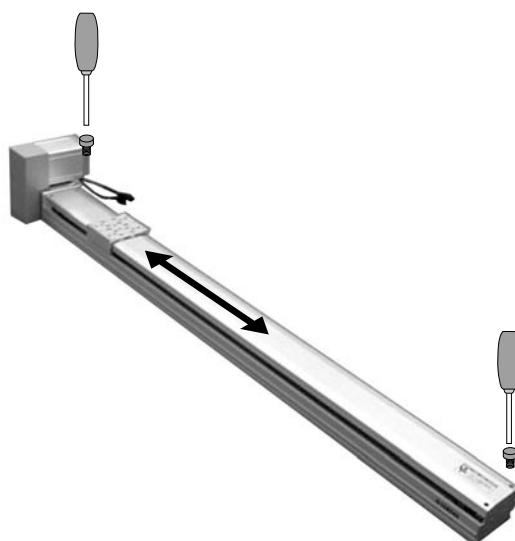
Step 8 Check the table movement.

Move the table by hand to check that the table movement is not heavy.

Step 4 Inserting the slider



Step 7 Reattaching the upper cover



2. Adjusting the timing belt tension (B10/B14/B14H)

The B10, B14 and B14H series robots use a timing belt to move the slider table.
If the tension of the timing belt is weak, follow the steps below to adjust the belt tension.



WARNING

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- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE ADJUSTMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



WARNING

THE MOTOR AND SPEED REDUCTION GEAR CASING ARE EXTREMELY HOT AFTER AUTOMATIC OPERATION, SO BURNS MAY OCCUR IF THESE ARE TOUCHED. BEFORE TOUCHING THESE PARTS, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THE PARTS HAVE COOLED.
INJURY CAN OCCUR IF HANDS OR FINGERS ARE SQUEEZED BETWEEN THE DRIVE PULLEY AND BELT. ALWAYS TURN OFF THE CONTROLLER AND USE CAUTION WHEN HANDLING THESE PARTS.



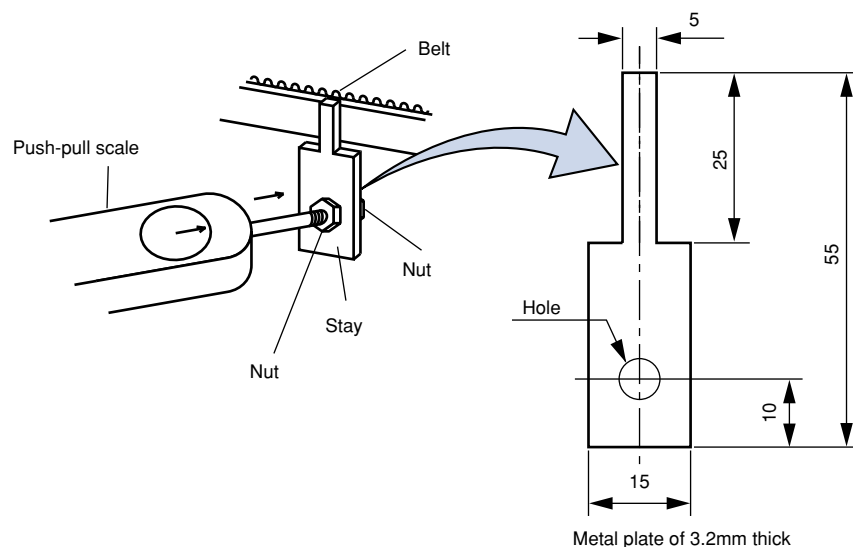
CAUTION

- Since a positional shift occurs after adjusting the belt tension, return-to-origin or absolute reset must be performed again and the point data re-specified.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Prepare tools necessary for the adjustment work

- Belt tension adjustment bolt (accessory)
- Push-pull scale
- Stay (The user must manufacture this stay while referring to the Fig. below.)
- Tension meter

Stay (example)



53303-AC-00

2.1 Adjusting the drive belt tension

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Take off the end cover.

Step 5 Remove the upper cover.

Remove the upper cover mounting screws and remove the upper cover.



CAUTION

On robot models having a long stroke, the slider is fitted in the travel guide (U groove) inside the upper cover, so remove the upper cover by sliding it along the direction the robot moves.

Step 6 Apply a tension to the belt.

1. Install the belt tension adjustment bolt supplied with the robot.
2. Loosen the belt stay mounting bolts (eight bolts).
3. Turn the adjustment bolt to apply a tension to the belt.

53305-AC-00

Step 7 Apply a load.

Move the slider by hand to a position at which the distance from the slider edge to the base block edge is 150mm. Apply a load to the belt at a position 115mm (B10) or 129mm (B14, B14H) away from the slider edge.

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53306-AC-00

Step 8 Tighten the belt stay mounting bolts temporarily.

Step 9 Check the slack amount.

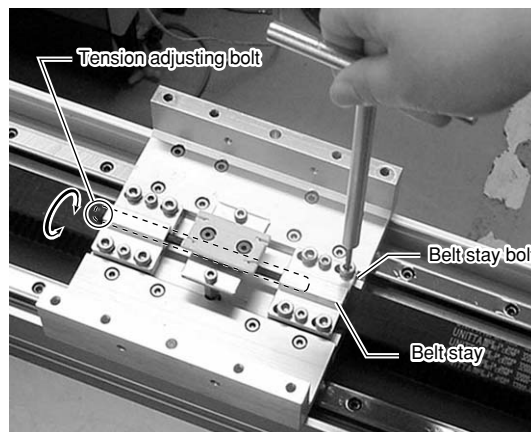
It is accepted that the slack is within the range stated in the table below when the belt is pushed with a specified load. If the slack is beyond the range, repeat Steps 5 and 6 to adjust the belt tension.

Load and slack for drive belt tension

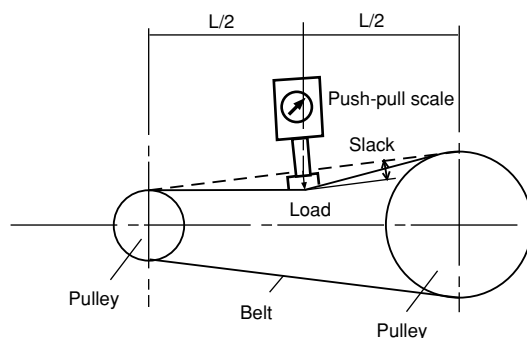
Robot model	Load		Slack (mm)
	(N)	(kgf)	
B10	4.9 to 5.9	0.5 to 0.6	2
B14/B14H	5.9 to 6.9	0.6 to 0.7	2

Step 10 Tighten the belt stay mounting bolts.

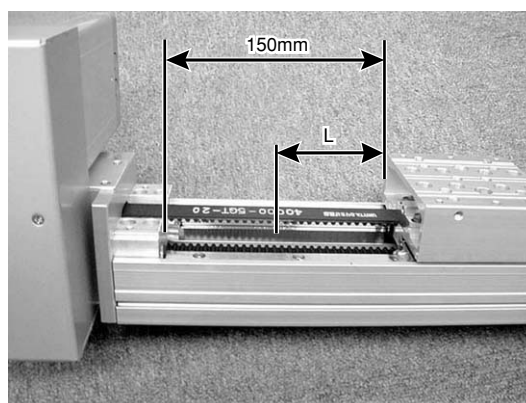
Step 6 Applying a tension



Step 7 Adjusting the speed reduction belt tension



Step 7 Load application position



Step 11 Remove the belt tension adjustment bolt.

Step 12 Reattach the upper cover and end cover.



NOTE

See also "1. Installing and removing the cover" in this Chapter.

Reference: Adjusting drive belt tension with a tension meter

We recommend using a tension meter to adjust the belt tension more accurately.

Recommended tension meter : U-505 (Made by UNITTA)

Measurement method

Pluck the belt at the load application position in Step 7 to adjust the belt tension to the value shown below.

For details on how to use the tension meter, refer to the tension meter Instruction Manual.

Robot model	Tension (N)	Frequency (Hz)	Span length (mm)	Belt width (mm)	Unit mass (g/width [mm] length [m])
B10	127 to 147	86 to 93	230	20	4.0
B14/B14H	169 to 188	79 to 84	258	25	4.0

2.2 Adjusting the speed reduction belt tension

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the belt cover.

53307-AC-00

Step 5 Measure the slack amount.

Apply the load shown in the table below to the center portion between both pulleys to measure the slack. When the slack is within the range stated in the table, no adjustment is needed.

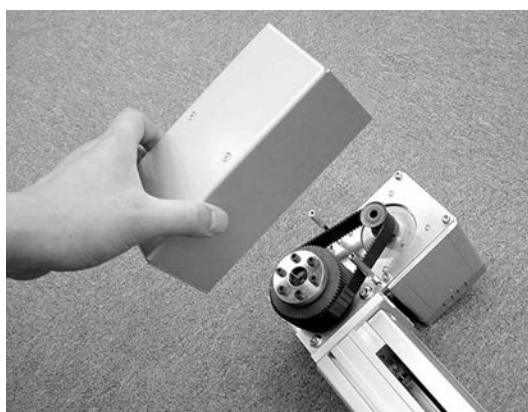
53308-AC-00

Load and slack for speed reduction belt tension

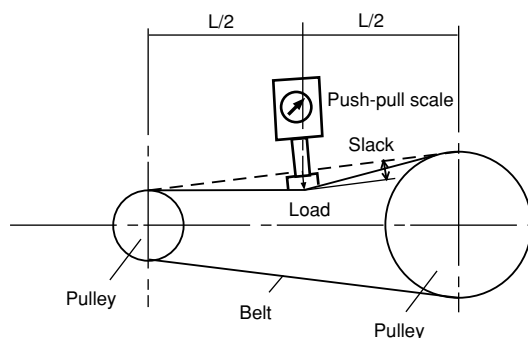
Robot model	Load		Slack (mm)
	(N)	(kgf)	
B10	5.9 to 6.9	0.6 to 0.7	3
B14/B14H	5.9 to 6.9	0.6 to 0.7	3

If the slack is beyond the range stated in the table above, go to the next Step.

Step 4 Removing the belt cover



Step 5 Measuring the slack amount



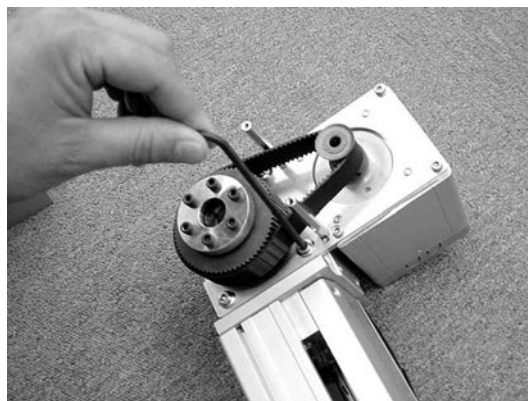
Step 6 Loosen the motor plate mounting bolts.

53309-AC-00

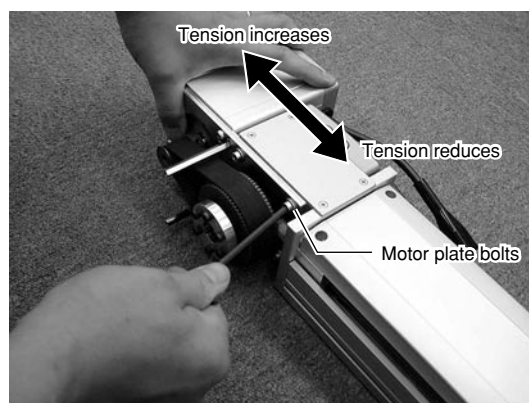
Step 7 Move the motor case to adjust the slack.

If the value that has been measured in Step 5 is smaller than the value shown in the table, move the motor case in the tension increase direction. Conversely, if the measured value is larger than the value shown in the table, move the motor case in the tension decrease direction.

53310-AC-00

Step 6 Loosening the motor plate mounting bolts**Step 8** Measure the belt tension again.

Follow Step 4 to measure the belt tension again. When the measured value is within the range shown in the table, the belt tension adjustment is completed. If the measured value is beyond the range, repeat Steps 5 to 7.

Step 7 Adjusting the slack**Step 9** Tighten the motor plate bolts securely.**Step 10** Reattach the belt cover.**Reference: Adjusting speed reduction belt tension with a tension meter**

We recommend using a tension meter to adjust the belt tension more accurately.

Recommended tension meter : U-505 (Made by UNITTA)

Measurement method

Pluck the belt at the load application position while referring to Step 5 so as to adjust the belt tension to the value shown below.

Robot model	Tension (N)	Frequency (Hz)	Span length (mm)	Belt width (mm)	Unit mass	
					(g/width [mm]	length [m])
B10	44 to 49	180 to 190	82	20	2.5	
B14/B14H	44 to 49	180 to 190	82	20	2.5	

3. Adjusting the timing belt tension (F20N)

The F20N robot uses a timing belt.

If the tension of the timing belt is weak, follow the steps below to adjust the belt tension.

First, the following describes how to install and remove the cover.



WARNING

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- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

3.1 Installing and removing the cover

3.1.1 Stroke cover

■ Removing the stroke cover

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the mounting screws from both ends.

Remove the mounting screws (M4, pan-head screws).

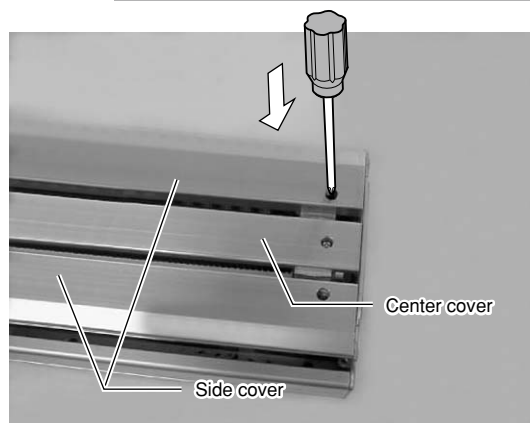
53302-A9-00

Step 5 Pull out the cover.

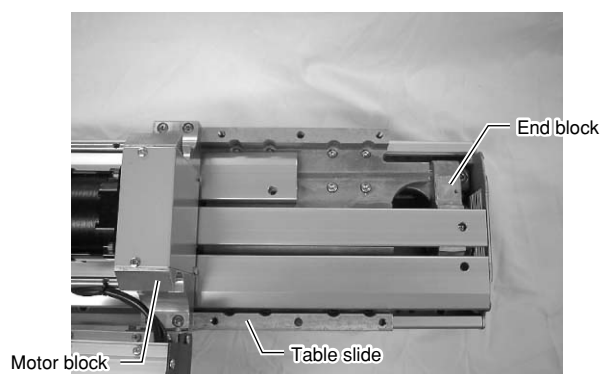
Move the table slide to the stroke end and pull out the cover.

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► Step 4 Removing the mounting screws



► Step 5 Pulling out the cover



■ Installing the stroke cover

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Pass the cover through the portion between the table slide and motor block.

Move the table slide to the stroke end and pass the cover through the portion between the table slide and motor block.

Step 5 Secure the cover to the end block.

Move the table slide to the center of the stroke and make sure that the table slide does not interfere with the cover. If the table slide interferes with the cover, tighten the cover mounting screws to make the adjustment.

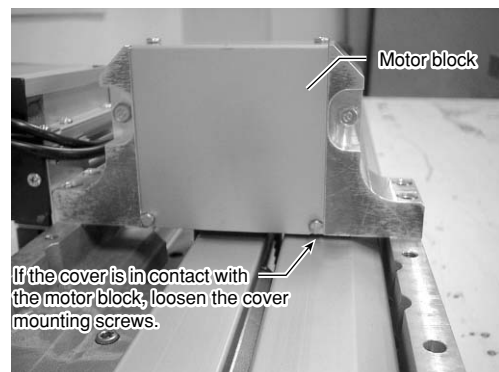
53303-A9-00

53304-A9-00

► **Step 5** Measures to be taken if the cover is in contact with the table slide.



► **Step 5** Measures to be taken if the cover is in contact with the motor block.



3.1.2 Belt cover

■ Removing the belt cover

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Loosen the hex socket-head bolts (M4).

Loosen the hex socket-head bolts (M4) (two bolts) with a spanner or socket wrench.

Step 5 Remove the belt cover.

After the screws (M4) have been removed from the top, pull out the cover upward.

53305-A9-00

■ Installing the belt cover

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Fit the cover.

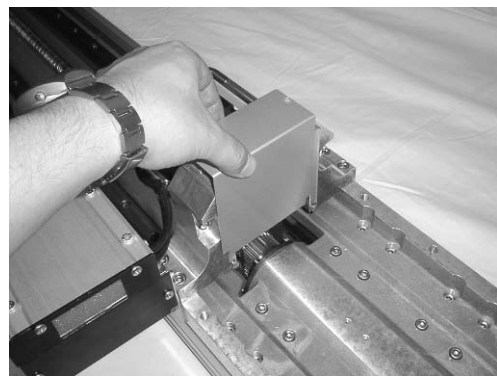
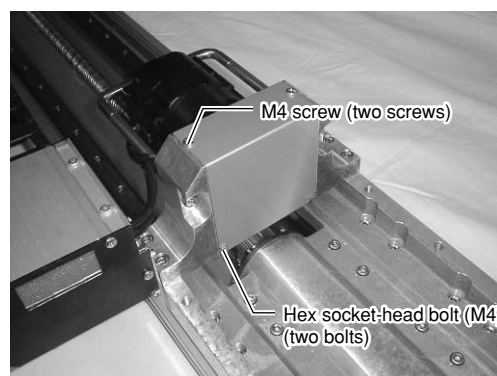
Fit the cover so that the notch of the cover passes through the portion between the hex socket-head bolts.

Step 5 Tighten the hex socket-head bolts.

Tighten the hex socket-head bolts with a spanner or socket wrench.

Step 6 Tighten the screws (M4) from the top to secure the cover.

► Step 5 Removing the belt cover



3.1.3 Motor cover

■ Removing the motor cover

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Cut the insulock-tie.

Cut the Insulock-tie binding the motor cable with a pair of nippers, and remove.

53306-A9-00

Step 5 Pull out the motor cover.

Remove the hex socket-head bolts (M4) (two bolts) and pull out the motor cover.

53307-A9-00

■ Installing the motor cover

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

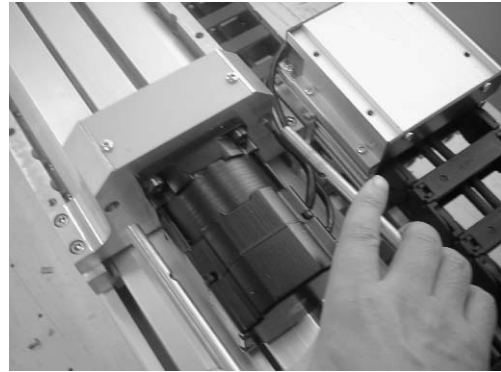
Step 4 Secure the motor cover.

Insert the motor cover into the mounting holes and secure it with the hex socket-head bolts (M6) (two bolts).

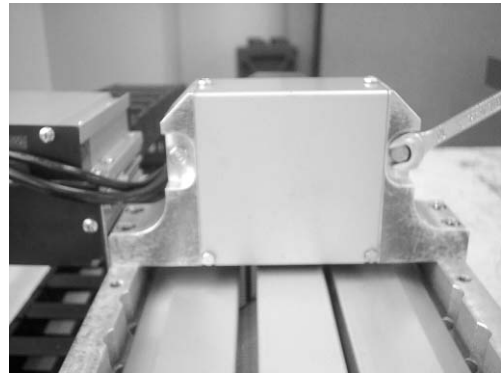
Step 5 Secure the cable with the insulock-tie.

Use the $\phi 5$ hole in the motor cover to secure the motor cable with the insulock-tie.

▶ **Step 4** Cutting the insulock-tie



▶ **Step 5** Pulling out the motor cover



3.2 Adjusting the timing belt tension



WARNING

THE MOTOR AND SPEED REDUCTION GEAR CASING ARE EXTREMELY HOT AFTER AUTOMATIC OPERATION, SO BURNS MAY OCCUR IF THESE ARE TOUCHED. BEFORE TOUCHING THESE PARTS, TURN OFF THE CONTROLLER, WAIT FOR A WHILE AND CHECK THAT THE PARTS HAVE COOLED.



WARNING

INJURY CAN OCCUR IF HANDS OR FINGERS ARE SQUEEZED BETWEEN THE DRIVE PULLEY AND BELT. ALWAYS TURN OFF THE CONTROLLER AND USE CAUTION WHEN HANDLING THESE PARTS.



CAUTION

Since a positional shift occurs after adjusting the belt tension, return-to-origin or absolute reset must be performed again and the point data re-specified.

Prepare tools necessary for the adjustment work

- Belt tension adjustment bolt (accessory)
- Tension meter

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Temporarily tighten the motor installation bolt.

Step 5 Install the adjustment bolt.

Remove the belt cover and install the adjustment bolt (M5).

Step 6 Apply a tension to the belt.

53308-A9-00

Step 7 Tighten the motor fixing bolt.

Step 8 Pluck the belt span with a hex. wrench.

Put the head of the measuring meter close to the belt and pluck the center of the belt span with a hex. wrench.

53309-A9-00

Step 9 Adjust the belt tension.

Adjust the belt tension by measuring the frequency with the tension meter while referring to the table below.

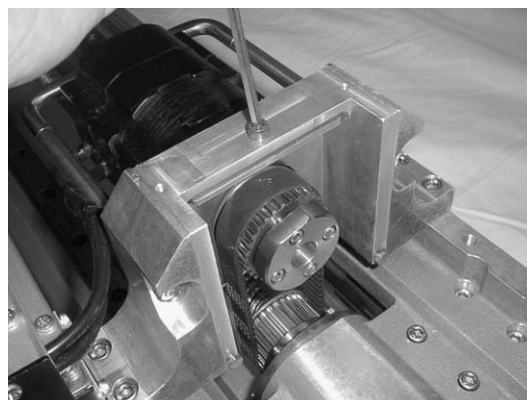
Recommended tension meter: U505 (made by UNITTA)

Frequency (Hz)	Tension		Span length (mm)	Belt unit weight (kg/m)
	(N)	(kg)		
207 to 219	88 to 98	9 to 10	100	0.051

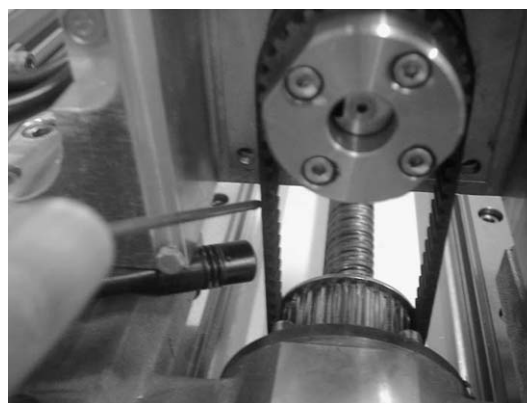
Step 10 After the belt tension has been adjusted to the proper level, measure the tension once again.

After the belt tension has been adjusted to the proper level, retighten the motor mounting bolts and measure the tension once again. As the bolts are retightened, the tension may increase. So, carefully check this point.

Step 11 Remove the adjustment bolt, and install the belt cover.



Step 8 Plucking the belt span with a hex. wrench.



4. Adjusting shutter looseness (T4L/T4LH/T5L/T5LH/T6L)

The shutter may elongate with continued use. In such cases, adjust as follows.



CAUTION

Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.

Prepare an appropriate Phillips screwdriver.



CAUTION

When the robot is installed vertically, slowly move the robot at a JOG speed to check the position where the shutter becomes loose mostly before entering the safety enclosure.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Loosen the screw lightly.

Lightly loosen the two screws securing the shutter on the end block side. (At this time, do not remove the screws.)

Step 5 Secure the shutter.

While stretching the shutter by fingers, tighten the screws to secure the shutter so that it does not become loose.



CAUTION

Do not press down on the shutter with excessive force.
Pressing down hard on the shutter may cause the shutter to warp.

Adjusting the looseness



53303-A1-00

Chapter 4 Replacement

Contents

1. Replacing the shutter (T4L/T4LH/T5L/T5LH/T6L)	4-1
2. Replacing the motor	4-3
2.1 T4L/T4LH/T5L/T5LH/T6L	4-3
2.2 F8/F8L/F8LH	4-5
2.3 B10/B14/B14H	4-8
2.4 F20N	4-9
2.5 N15/N15D/N18/N18D	4-11
2.6 Checking the grid position	4-15
3. Replacing the insert (T4L/T4LH/T5L/T5LH/T6L)	4-16
4. Replacing the drive and speed reduction belts (B10/B14/B14H)	4-18
4.1 Replacing the drive belt	4-18
4.2 Replacing the speed reduction belt	4-20
5. Replacing the slider	4-21
5.1 B10/B14/B14H	4-21
5.2 F20N	4-22
6. Maintenance parts	4-23
6.1 Consumable parts	4-23

1. Replacing the shutter (T4L/T4LH/T5L/T5LH/T6L)

When the shutter needs to be replaced, follow the steps below.



WARNING

- BEFORE STARTING THE REPLACEMENT WORK, BE SURE TO DISCONNECT THE ROBOT FROM THE CONTROLLER OR TURN OFF THE CONTROLLER POWER. IF THE ROBOT OPERATES DURING THE REPLACEMENT WORK, THIS MAY CAUSE SERIOUS ACCIDENT.
- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPLACEMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the slider cover.

Remove the four screws securing the slider cover and remove the slider cover.

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Step 5 Remove the screws.

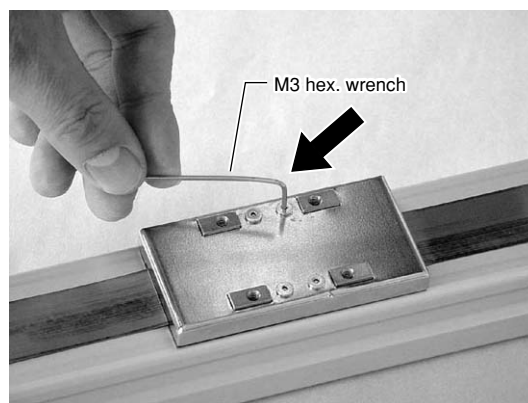
Remove the screws (two screws each) securing the shutter from the end block and motor.

53402-A1-00

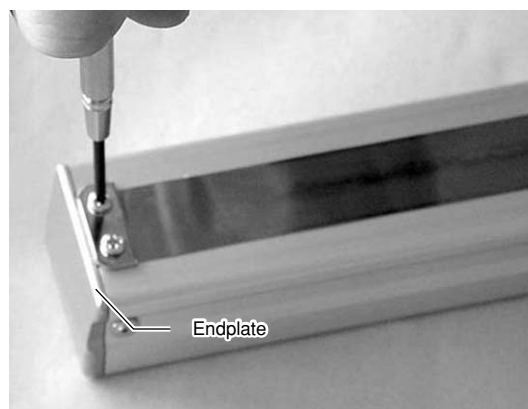
Step 6 Pull out the shutter.

Pull out the shutter from the shutter passing portion.

Step 4 Removing the slider cover



Step 5 Removing the shutter mounting screws



Step 7 Pass a new shutter.

53403-A1-00

Step 8 Reinstall the shutter and the slider cover using the reverse of the above procedure.



NOTE

Do not fully tighten the screws to secure the shutter on the endplate side at this time. Fully tighten these screws after adjusting for shutter looseness in step 9.

Step 9 Secure the shutter.

Tighten the screws while pulling on the shutter with your fingers so that there is no looseness in the shutter.

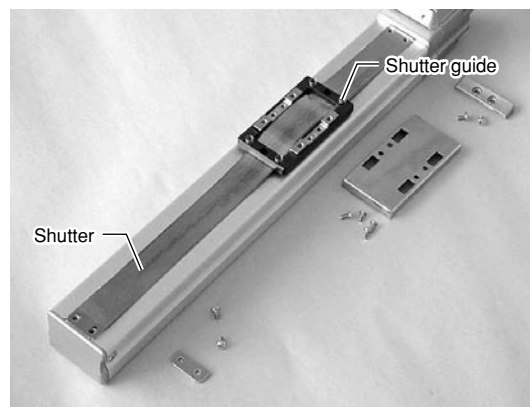
53404-A1-00



CAUTION

Do not press down on the shutter with excessive force. Pressing down hard on the shutter may cause the shutter to warp.

Step 7 Replacing the shutter



Step 9 Adjusting the shutter looseness



2. Replacing the motor

2.1 T4L/T4LH/T5L/T5LH/T6L



WARNING

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- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPLACEMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Since a positional shift occurs after replacing the motor, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the parts securing the shutter.

Remove the two M4 screws securing the shutter from each of the end block and motor sides.

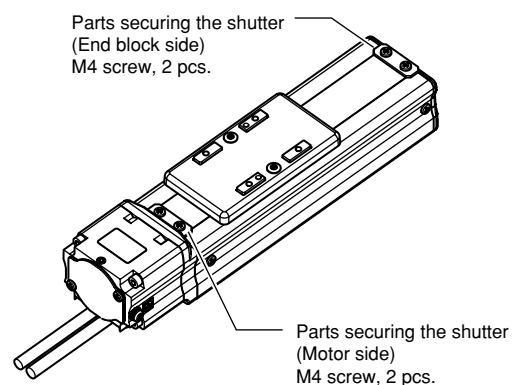
53413-A1-00

Step 5 Remove the cover stroke.

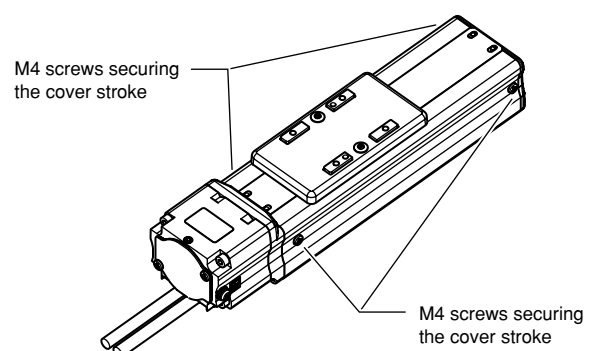
Remove the two M4 screws securing the cover stroke from each of the left and right.

53414-A1-00

► **Step 4** Removing the parts securing the shutter



► **Step 5** Removing the cover stroke



Step 6 Remove the bolts securing the motor.

Remove the two M5 bolts securing the motor.

53415-A1-00

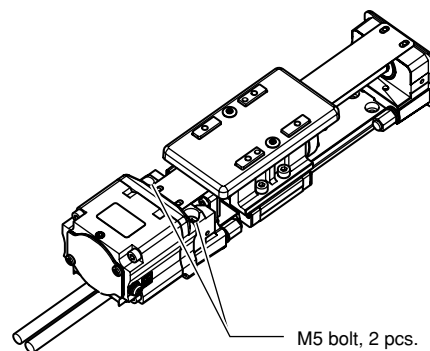
Step 7 Remove the motor.

53416-A1-00

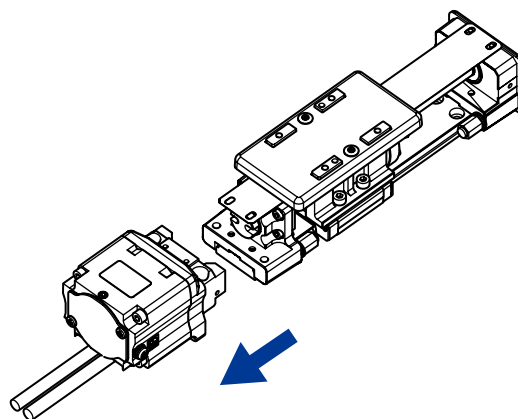
Step 8 Install a new motor.

Step 9 Assemble in the reverse order of disassembly (Step 6 → Step 4).

► **Step 6** Removing the bolts securing the motor



► **Step 7** Removing the motor



2.2 F8/F8L/F8LH



WARNING

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- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Since a positional shift occurs after replacing the motor, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

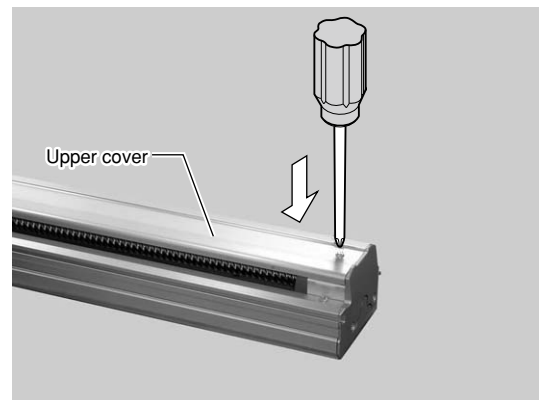
Step 3 Enter the safety enclosure.

Step 4 Remove the upper cover of the robot.

Remove the three screws securing the upper cover of the robot and remove the upper cover.

53401-A5-00

► **Step 4** Removing the upper cover



Step 5 Remove the side cover.

Remove the two screws securing each side cover and remove the side covers.

53402-A5-00

Step 6 Remove the end cover on the motor side.

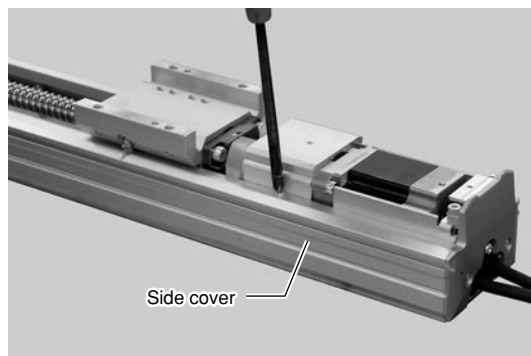
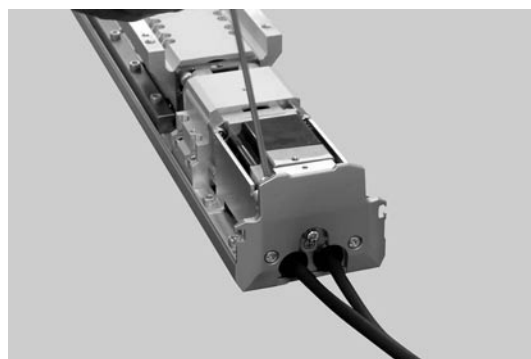
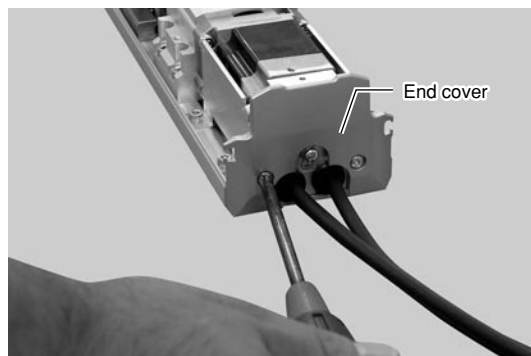
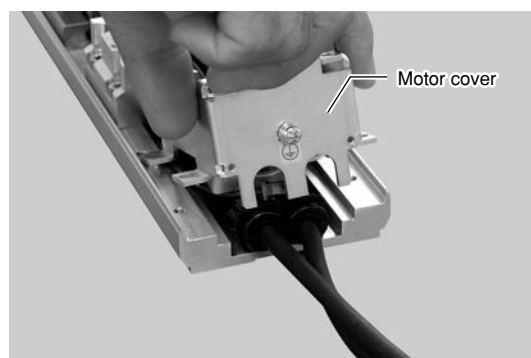
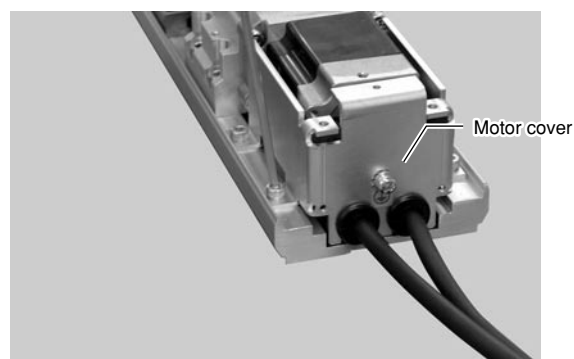
Remove the four screws securing the end cover on the motor side and remove the cover.

53403-A5-00

Step 7 Remove the motor cover.

Remove the four screws securing the motor cover and remove the motor cover.

53404-A5-00

Step 8 Remove the ground wire.**Step 5** Removing the side cover**Step 6** Removing the end cover on the motor side**Step 7** Removing the motor cover

Step 9 Remove the motor.

Remove the four bolts securing the motor and remove the motor.

53405-A5-00

Step 10 Remove the wave washer and flat washer.**CAUTION**

When removing the motor, the flat washer might be left in the bearing inside the motor, so use caution.

53406-A5-00

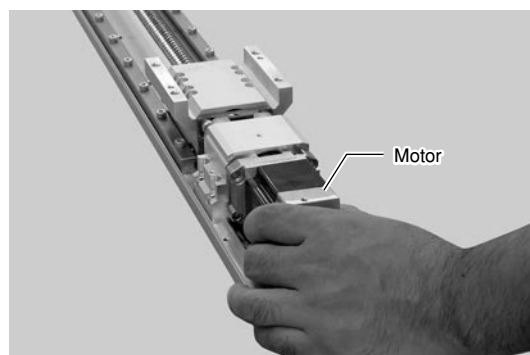
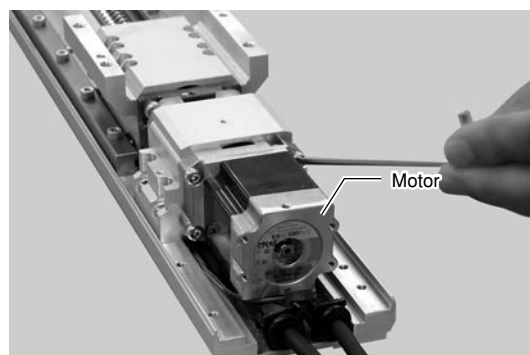
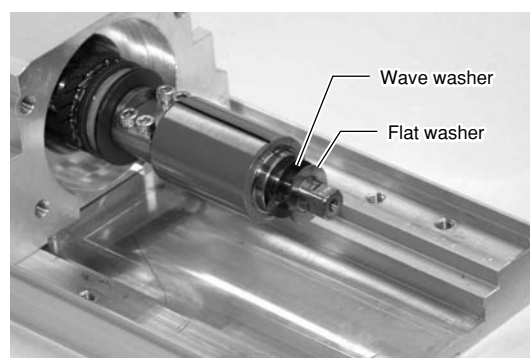
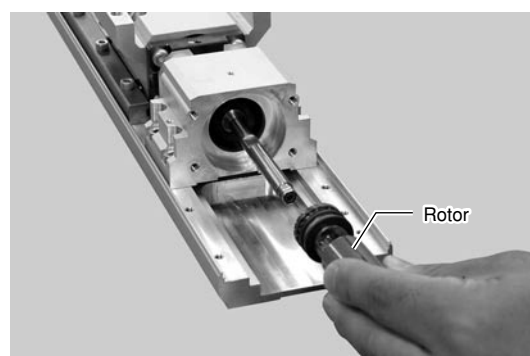
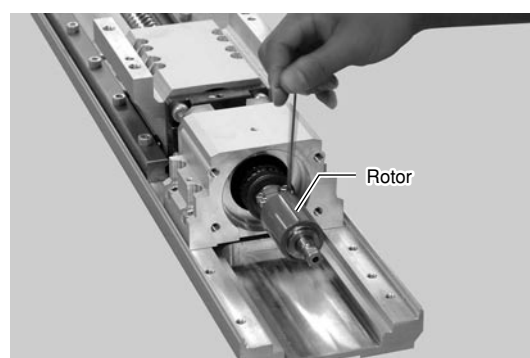
Step 11 Pull out the rotor.

Remove the four bolts securing the rotor and pull out the rotor.

53407-A5-00

Step 12 Install the new rotor.**Step 13** Install the wave washer and flat washer.

Carefully check the wave washer and flat washer installation order.

Step 14 Install the new motor.**Step 15** Assemble in the reverse order of disassembly (Step 13 → Step 4).**Step 9** Removing the motor**Step 10** Removing the wave washer and flat washer**Step 11** Pulling out the rotor

2.3 B10/B14/B14H



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CAUTION

- Since a positional shift occurs after replacing the motor, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the belt cover.

Step 5 Remove the motor case and motor cover.

53401-AC-00

Step 6 Remove the motor.

Remove the four motor mounting bolts and remove the motor.

53402-AC-00

Step 7 Remove the pulley.

Loosen the two set screws of the pulley and remove the pulley.

53403-AC-00

Step 8 Replace the motor with a new one and attach the pulley to this new motor.

At this time, insert the pulley so that the D face of the motor shaft is in contact with the set screws (two locations) vertically. Projecting the set screws approx. 0.1 to 0.2mm will ensure the easy assembly work.

Step 9 Install the motor to the motor plate.

Step 10 Fit the belt onto the pulleys.

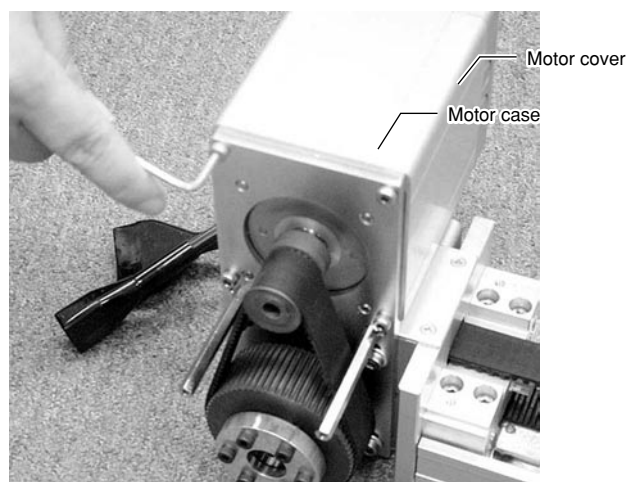
Step 11 Adjust the belt tension.

Adjust the belt tension while referring to "2. Adjusting the timing belt tension (B10/B14/B14H)" in Chapter 3.

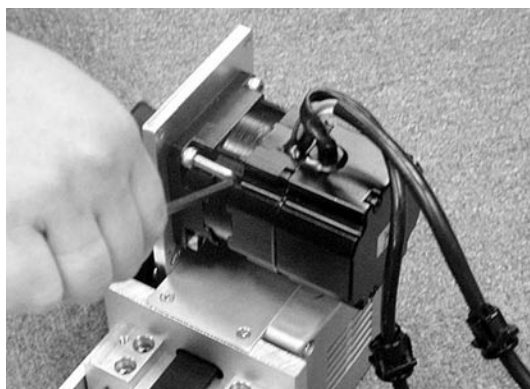
Step 12 Reattach the motor case and cover.

Step 13 Reattach the belt cover.

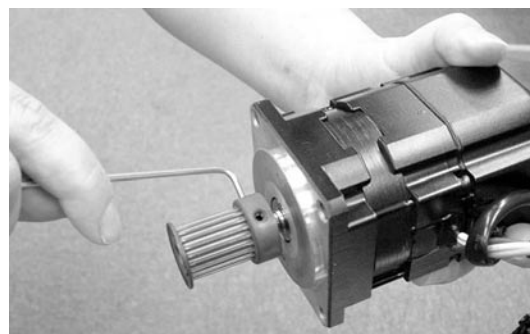
Step 5 Removing the motor case and motor cover



Step 6 Removing the motor



Step 7 Removing the pulley



2.4 F20N



WARNING

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CAUTION

- Since a positional shift occurs after replacing the motor, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the belt cover and motor cover.



NOTE

For details about how to remove the cover, see "3.1 Installing and removing the cover" in Chapter 3.

Step 5 Disconnect the motor cable connectors.

Open the wiring box cover that is secured to the table slide and disconnect the motor cable connectors.

53401-A9-00

Step 6 Remove the four motor mounting bolts (M6).

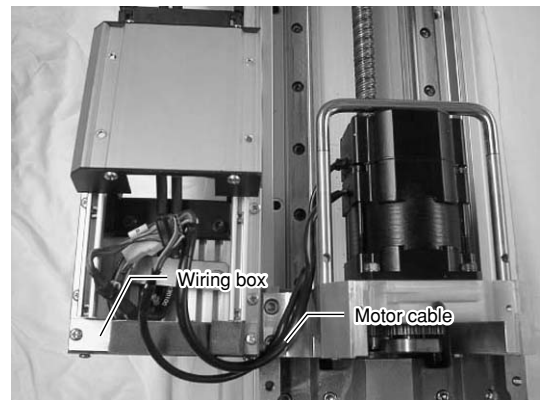
53402-A9-00

Step 7 Pull the belt off the pulley.

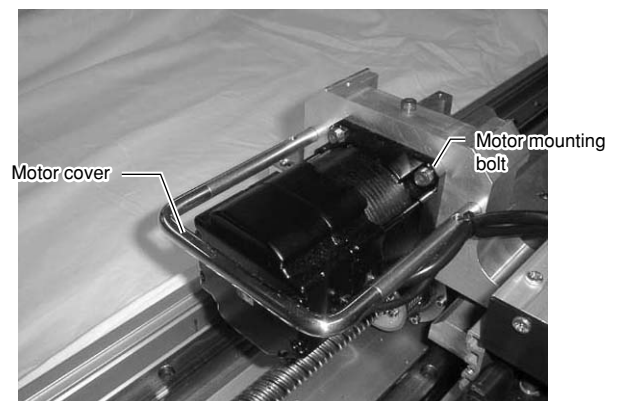
53403-A9-00

Step 8 Remove the motor.

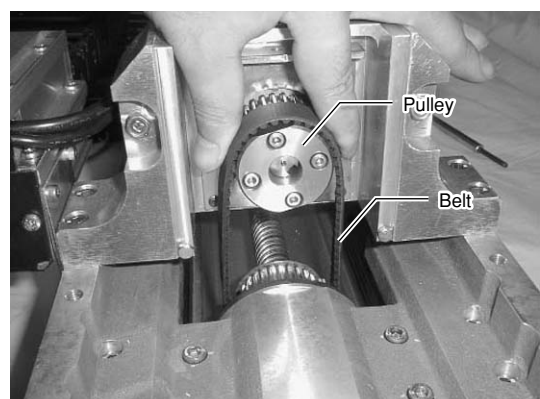
► **Step 5** Disconnecting the motor cable connectors



► **Step 6** Removing the motor mounting bolts



► **Step 7** Removing the belt



Step 9 Pull out the pulley from the motor.

Remove the four bolts (M6) securing the pulley fastening boss and pull out the pulley from the motor.

Loosen the bolts while securing the machined surface of the boss with pliers.

53404-A9-00

Step 10 Replace the motor with a new one and attach the pulley to this new motor.

Take care to the orientation and order of the rings at this time.

53405-A9-00

Step 11 Install the motor onto the block.

Temporarily tighten the fixing bolts.

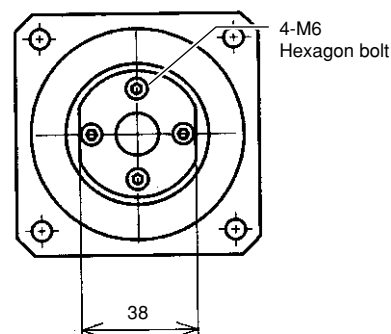
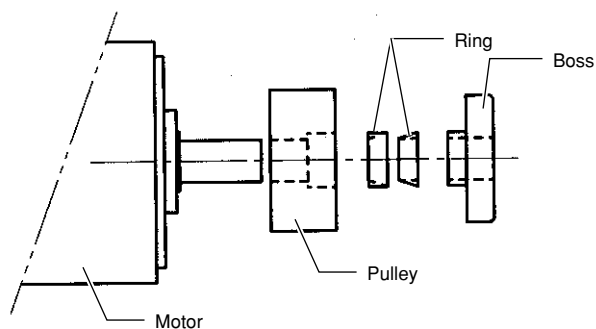
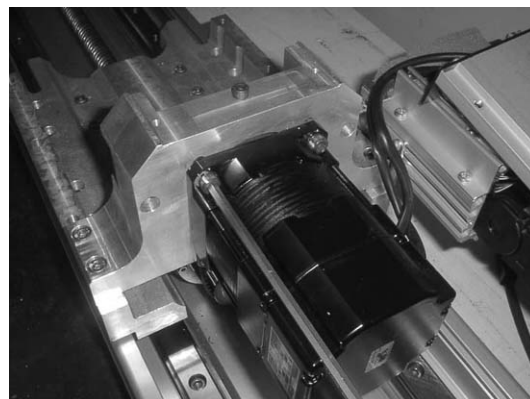
53406-A9-00

Step 12 Install the belt.

Adjust the belt tension while referring to "3 Adjusting the timing belt tension (F20N)" in Chapter 3.

Step 13 Reattach the motor cover and belt cover.**Step 14 Reattach the cover.**

Connect the motor cable connectors, store the cables in the wiring box, and reattach the cover.

Step 9 Removing the mounting bolts**Step 10 Attaching the pulley****Step 11 Installing the motor**

2.5 N15/N15D/N18/N18D



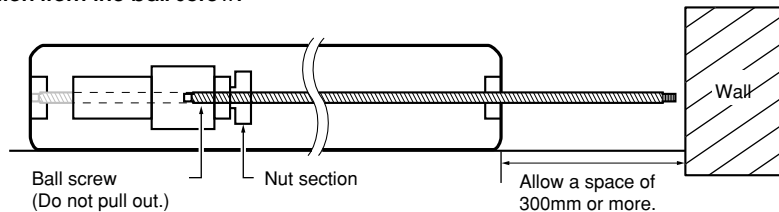
WARNING

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CAUTION

- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.
- Since a positional shift occurs after replacing the motor, return-to-origin must be performed again and the point data re-specified. When removing the parts, note their positional relation and assembly order.
- Provide a space of at least 300mm between each end of the robot and the wall. Do not pull out the ball screw nut section from the ball screw.



Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the end covers 1 (upper end covers) from both ends of the robot.



NOTE

For details about how to remove the cover, see "3. Installing the robot" in Chapter 2 of the Installation Manual.

Step 5 Remove the upper cover.

Remove the four screws securing the upper cover of the robot and remove the upper cover.

Step 6 Remove the end cover 2 (located at the lower portion) from both ends.

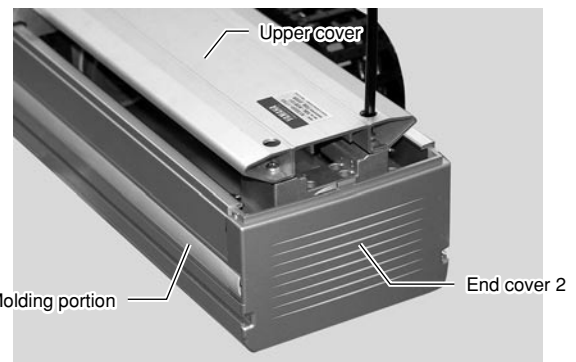
Remove the two screws securing the end cover of the robot and remove the end cover 2. For the N15 robot, turn over the molding portion, remove the screws (two screws each on the left and right), and remove the end cover 2.

53402-AA-00

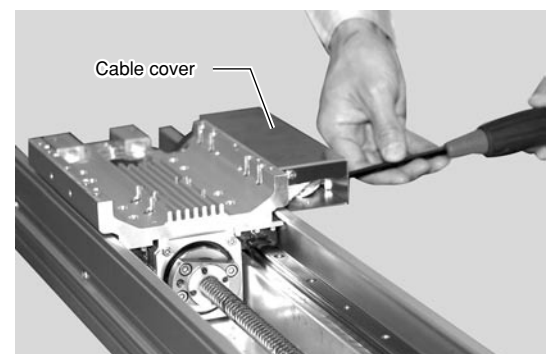
Step 7 Remove the cable cover.

53403-AA-00

Step 5-6 Removing the cover



Step 7 Removing the cable cover



Step 8 Disconnect the power cable and signal cable.

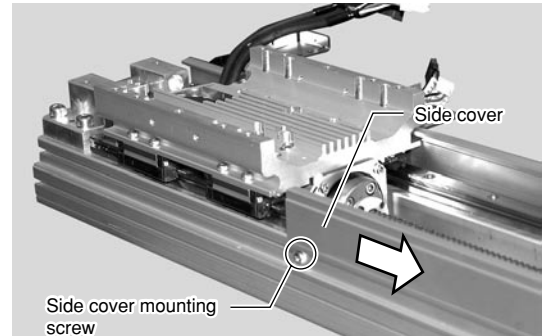
Use diagonal cutters to cut the insulock-ties securing the motor cable and disconnect the power cable and signal cable.

Step 9 Move the side cover.

Loosen the screw securing the side cover and slide the side cover in the direction of arrow to a position that allows access to the motor unit.
(The N18 robot has no side cover, so skip this step.)

53404-AA-00

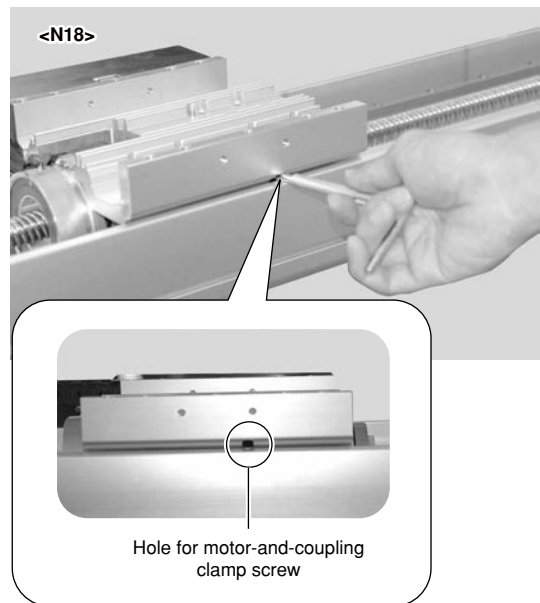
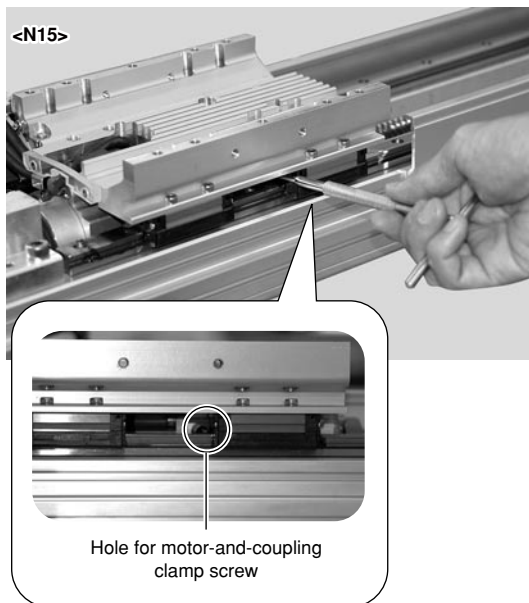
Step 9 Moving the side cover



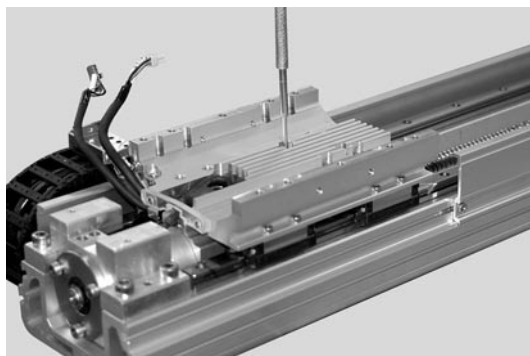
Step 10 Free the table slider and motor coupling.

Freeing the coupling

- When workpiece is on table slider



- When no workpiece is on table slider



53405-AA-00

Step 11 Remove the U-nut and washer.

Secure the notched portion of the ball screw with a spanner and remove the U-nut and washer.

53406-AA-00

Step 12 Loosen the bolts securing the ball screw.

Loosen the four bolts securing the ball screw on the opposite side.

53407-AA-00

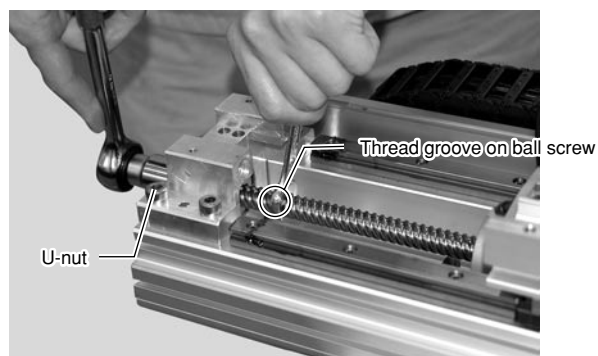
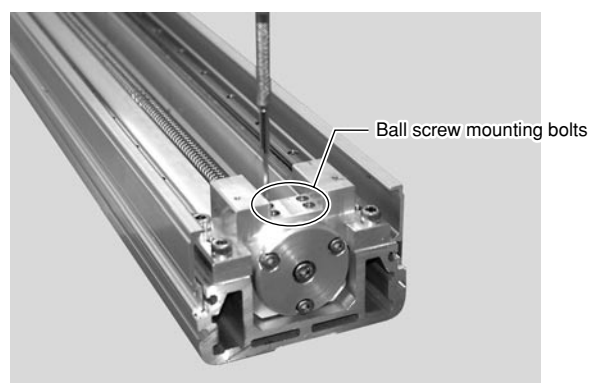
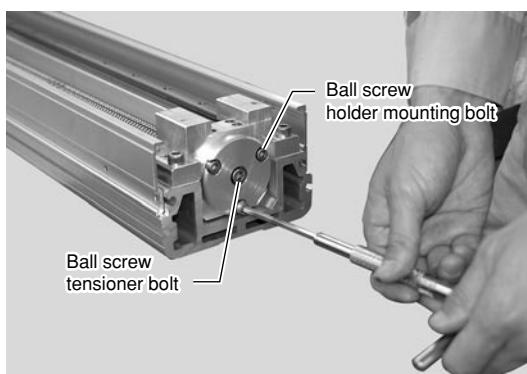
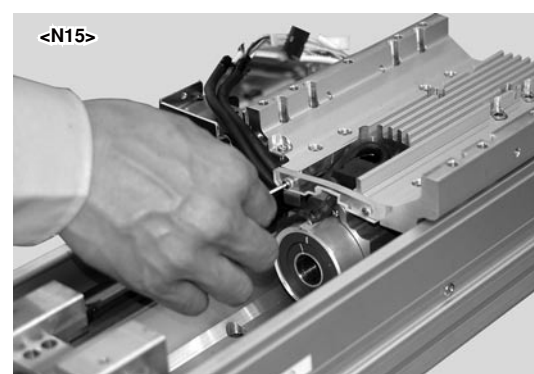
Step 13 Remove the three bolts securing the holder and remove the one ball screw tension bolt.

53408-AA-00

Step 14 Remove the two screws securing the damper.

Skip this step for the N18 robot.

53409-AA-00

Step 11 Removing the U-nut and washer**Step 12** Loosening the bolts securing the ball screw**Step 13** Removing the bolts**Step 14** Removing the bolts securing the damper

Step 15 Remove the motor.

Remove the four screws securing the motor and remove the motor. At this time, be careful not to allow the ball screw shaft to come out of the nut.

53410-AA-00

53411-AA-00

Step 16 Install a new motor.

Tighten the bolts to the following torque.

Robot	Bolt	Tightening torque
N15	Hex socket-head bolt (M5)	60kgf•cm to 90kgf•cm
N18	Hex socket-head bolt (M6)	100kgf•cm to 130kgf•cm

Step 17 Assemble in the reverse order of disassembly.

Proceed while making sure the positional relation and assembly order of the parts are correct.



CAUTION

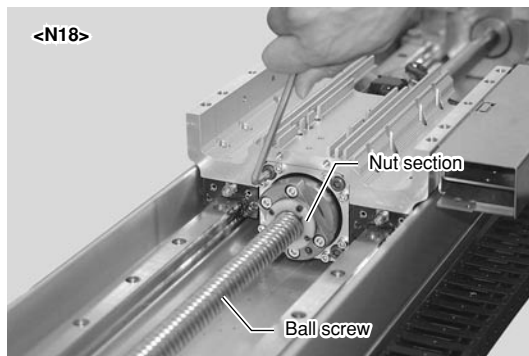
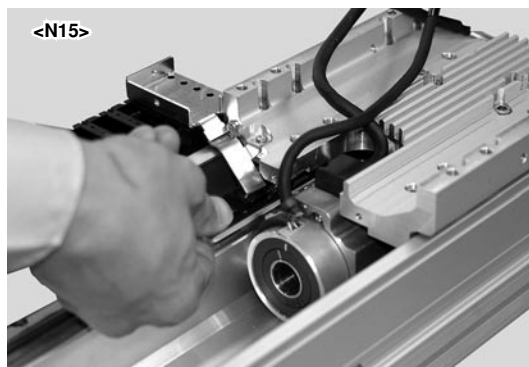
When installing the ball screw, apply the proper amount of molybdenum grease to the clamp portion (see photo below).

53412-AA-00

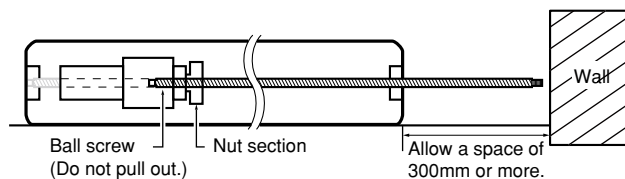
Step 18 Adjust the coupling position and secure the coupling.

After replacing the motor, adjust the coupling position so that the grid position is within $50 \pm 20\%$, which is displayed by performing return-to-origin.

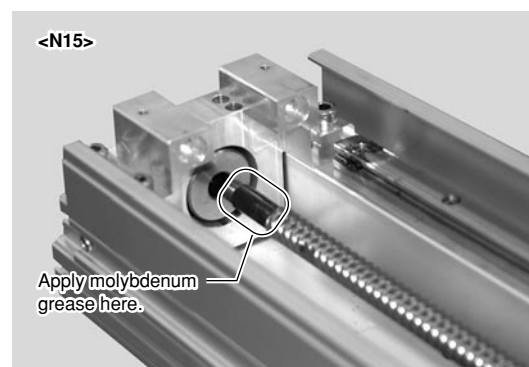
Step 15 Removing the motor



Step 15 Cautions on motor removal work



Step 17 Applying the grease



2.6 Checking the grid position

After the motor has been replaced, follow the steps below to perform the return-to-origin and check the grid position.

The following describes how to check the grid position of the model SR1. For other controller models, see the manual for relevant controller model.

Step 1 Press (**OPRT**) on the initial menu screen.

54401-A0-00

Step 2 Press (**ORG**).

54402-A0-00

Step 3 Press (yes) to perform return-to-origin.

To cancel the operation, press (no).

54403-A0-00

Step 4 This screen appears during return-to-origin.

Pressing during operation stops the robot and displays a message. Then pressing returns to the screen of step 2.

Step 5 When return-to-origin ends normally, the machine reference value appears on the bottom right of the screen.

Step 6 Press to display the grid position.

54404-A0-00

► **Step 1** Initial menu screen

```
[MENU]
select menu
1EDIT 2OPRT 3SYS 4MON
```

► **Step 2** Operation mode

```
[OPRT]
select menu
1ORG 2STEP 3AUTO
```

► **Step 3-4** Return-to-origin

```
[OPRT-ORG-SEARCH]
ORG search OK ?
1yes 2no
```

```
[OPRT-ORG-SEARCH]
searching ...
```

► **Step 6** Grid position display

```
[OPRT-ORG-SEARCH]
origin complete
grid position 50%
```

3. Replacing the insert (T4L/T4LH/T5L/T5LH/T6L)



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CAUTION

- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the parts securing the shutter.

Remove the two M4 screws securing the shutter from each of the end block and motor sides.

53417-A1-00

Step 5 Remove the cover stroke.

Remove the two M4 screws securing the cover stroke from each of the left and right.

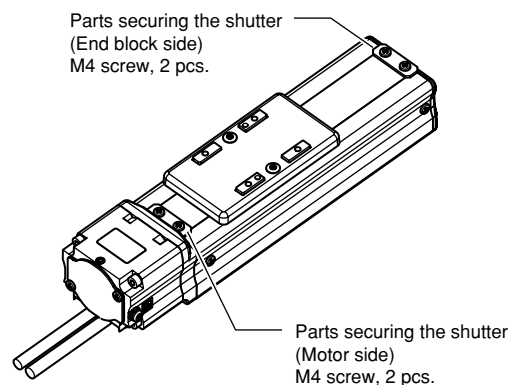
53418-A1-00

Step 6 Remove the bolts securing the motor.

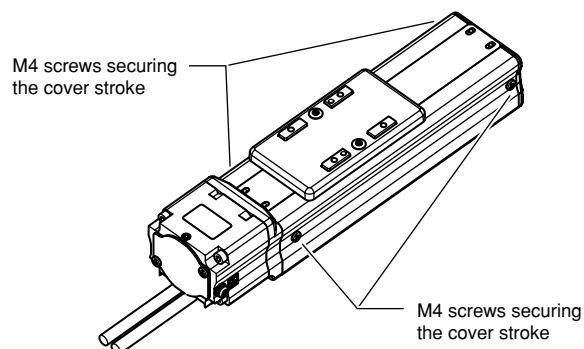
Remove the two M5 bolts securing the motor.

53419-A1-00

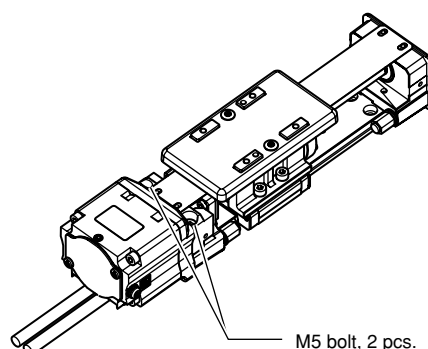
Step 4 Removing the parts securing the shutter



Step 5 Removing the cover stroke



Step 6 Removing the bolts securing the motor



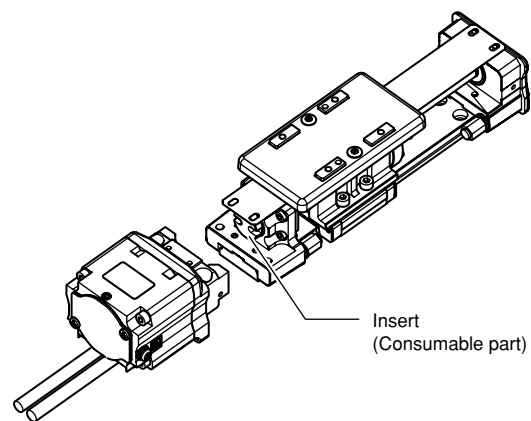
Step 7 Remove the insert.

53420-A1-00

► **Step 7** Removing the insert

Step 8 Install a new insert.

Step 9 Assemble in the reverse order of disassembly (Step 6 → Step 4).



4. Replacing the drive and speed reduction belts (B10/B14/B14H)

4.1 Replacing the drive belt



WARNING

- BEFORE STARTING THE REPLACEMENT WORK, BE SURE TO DISCONNECT THE ROBOT FROM THE CONTROLLER OR TURN OFF THE CONTROLLER POWER. IF THE ROBOT OPERATES DURING THE REPLACEMENT WORK, THIS MAY CAUSE SERIOUS ACCIDENT.
- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPLACEMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Since a positional shift occurs after replacing the belt, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the end cover.

Remove the end cover from the anti-motor end.

Step 5 Remove the upper cover.

For models with a long stroke, pull out the cover parallel with the axis movement direction.

Step 6 Remove the motor.

Remove the motor while referring to "2.2 B10/B14/B14H" of "2. Replacing the motor" in this Chapter. (It is unnecessary to remove the motor if installed horizontally or downwards.)

Step 7 Remove the cover 1.

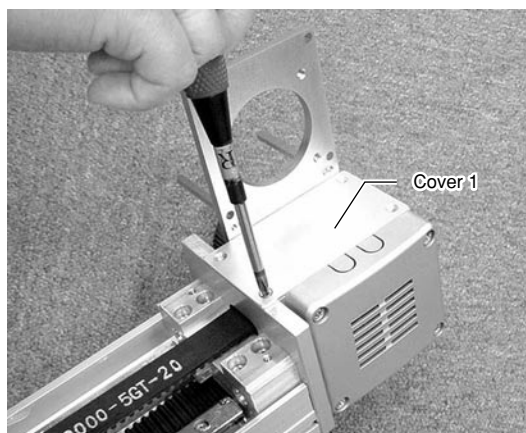
53404-AC-00

Step 8 Remove the belt stay.

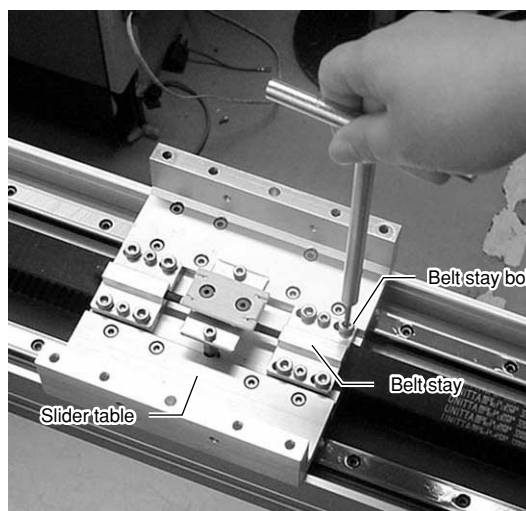
Remove the belt stay bolts (four bolts x 2) and remove the belt stay from the slider table.

53405-AC-00

Step 7 Removing the cover 1



Step 8 Removing the belt stay



Step 9 Detach the belt.

Remove the belt stay bolts (two bolts x 2) and detach the belt from the main unit.

53406-AC-00

Step 10 Attach a new belt.**Step 11 Attach the belt.**

1. First, attach the belt from the upper side of the driven pulley and push it out with a thin rod.

53407-AC-00

2. Pass the belt through from the lower side of the slider table and route the belt edge under the drive pulley. Then, use a narrow rod or similar tool to make the belt edge face upwards.
3. Finally, while making the belt mesh between the drive pulley and drive pulley idler, turn the drive pulley so the belt comes out upwards.

Step 12 Attach the belt stays to both ends of the belt.**Step 13 Reattach the belt stay to the table.**

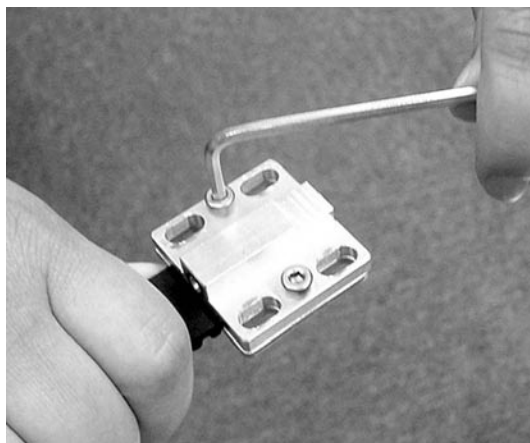
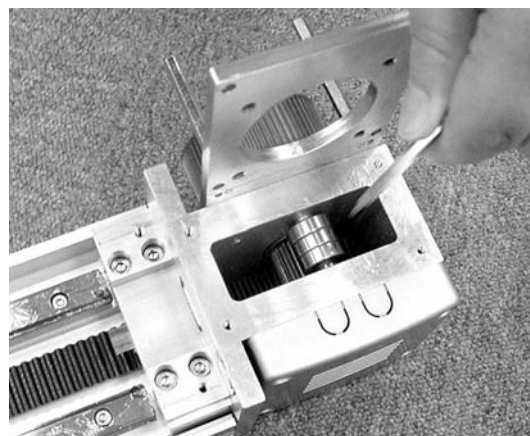
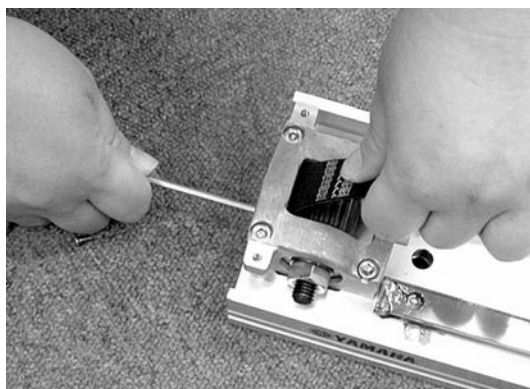
Tighten the belt stay mounting bolts temporarily.

Step 14 Adjust the belt tension.

For details, see "2. Adjusting the timing belt tension (B10/B14/B14H)" in Chapter 3.

Step 15 Reattach the upper cover.

For details, see "1. Installing and removing the cover" in Chapter 3.

Step 16 Reattach the end cover.**Step 9 Removing the belt stay****Step 11 Attaching the belt**

4.2 Replacing the speed reduction belt



WARNING

- BEFORE STARTING THE REPLACEMENT WORK, BE SURE TO DISCONNECT THE ROBOT FROM THE CONTROLLER OR TURN OFF THE CONTROLLER POWER. IF THE ROBOT OPERATES DURING THE REPLACEMENT WORK, THIS MAY CAUSE SERIOUS ACCIDENT.
- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPLACEMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Since a positional shift occurs after replacing the belt, return-to-origin must be performed again and the point data re-specified. When removing the parts, check and mark the part positions versus each other so you can correctly reassemble the parts later.
- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the belt cover

53408-AC-00

Step 5 Remove the motor plate bolts (4 pieces).

53409-AC-00

Step 6 Move the motor plate to a side where the belt becomes loose and detach the belt from the pulleys.

Move the motor plate to the loosening side and detach the belt.

Step 7 Attach the belt.

First, attach a new belt onto the small pulley, and then fit it to the large pulley.

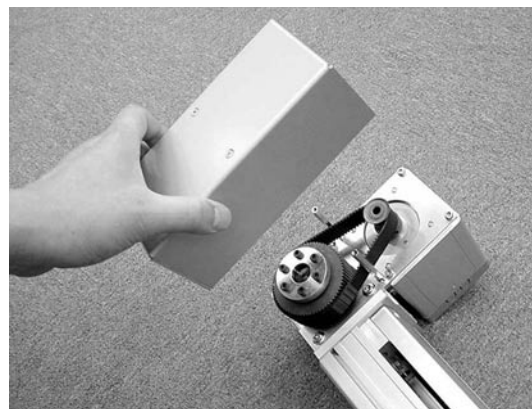
53410-AC-00

Step 8 Adjust the belt tension.

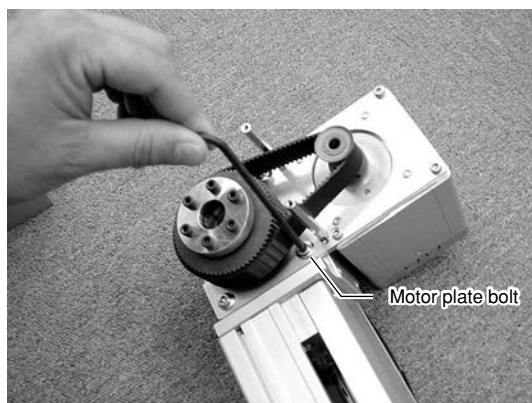
For details, see "2. Adjusting the timing belt tension (B10/B14/B14H)" in Chapter 3.

Step 9 Reattach the belt cover.

► **Step 4** Removing the belt cover



► **Step 5** Removing the motor plate bolts



► **Step 7** Attaching the belt



5. Replacing the slider

5.1 B10/B14/B14H



WARNING

- BEFORE STARTING THE REPLACEMENT WORK, BE SURE TO DISCONNECT THE ROBOT FROM THE CONTROLLER OR TURN OFF THE CONTROLLER POWER. IF THE ROBOT OPERATES DURING THE REPLACEMENT WORK, THIS MAY CAUSE SERIOUS ACCIDENT.
- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPLACEMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the upper cover.

Pull out the upper cover parallel with the axis movement direction.

Step 5 Remove the slider mounting bolts (2 pieces).

53411-AC-00

Step 6 Replace the slider.

Secure a new slider temporarily with the mounting bolts (2 pieces).

Step 7 Reattach the upper cover.

For details, see "Installing and removing the cover" in Chapter 3.

Step 8 Move the slider table back and forth along the axis a few times.

Step 9 Move the slider.

Peel off the seal with a diameter of 12mm from the upper cover on the anti-motor side. Move the slider to a position where the slider mounting bolts can be seen from this hole.

51412-AC-00

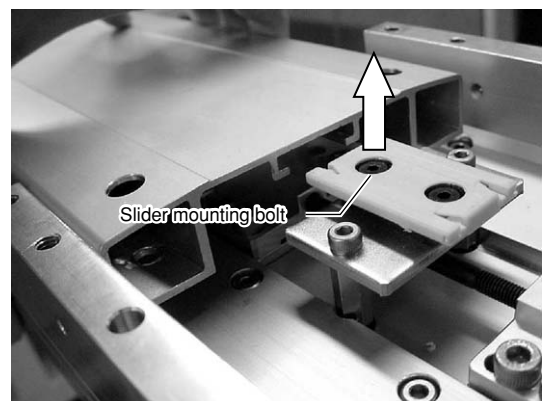
Step 10 Retighten the slider mounting bolts.

Tighten the slider mounting bolts fully, then again shift the slider table 20mm to align the other bolt with the hole and fully tighten to secure the slider table.

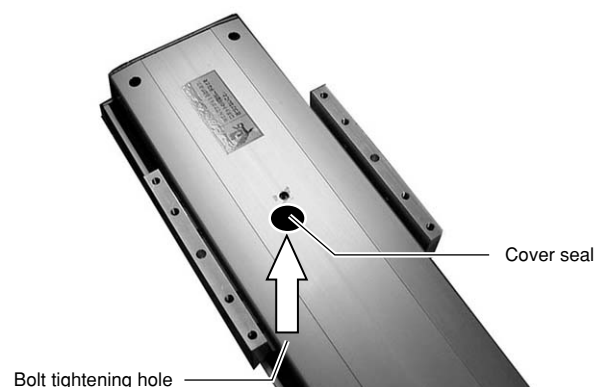
Step 11 Adhere the accessory seal.

Adhere the accessory seal to close the hole.

Step 5 Removing the slider mounting bolts



Step 9 Cover seal



5.2 F20N



WARNING

- BEFORE STARTING THE REPLACEMENT WORK, BE SURE TO DISCONNECT THE ROBOT FROM THE CONTROLLER OR TURN OFF THE CONTROLLER POWER. IF THE ROBOT OPERATES DURING THE REPLACEMENT WORK, THIS MAY CAUSE SERIOUS ACCIDENT.
- ONLY QUALIFIED ENGINEERS WHO HAVE THE SKILL AND LICENSE IN ACCORDANCE WITH THE LAWS AND REGULATIONS IN EACH COUNTRY ARE ALLOWED TO CARRY OUT THE REPLACEMENT WORK WITH THE COVER REMOVED.
- BE CAREFUL NOT TO NEGLECT TIGHTENING SCREWS OR BOLTS. IF ANY COVER IS NOT SECURED FIRMLY, THIS MAY CAUSE NOISE, COVER DROPPING AND FLYING, HAND ENTANGLEMENT IN DRIVE UNIT DURING TEACHING, OR BURN DUE TO HAND IN CONTACT WITH HOT SURFACE. SO, BE SURE TO TIGHTEN ALL THE SCREWS AND BOLTS SECURELY.



CAUTION

- Be sure to wear safety gloves before starting the work. If you touch any steel material part by bare hand, this may cause rust.
- Be careful not to drop any screw or bolt during cover removal work.

Step 1 Turn off the controller power.

Step 2 Place a sign indicating the robot is being adjusted.

Place a sign indicating the robot is being adjusted, to keep others from operating the controller or operation panel.

Step 3 Enter the safety enclosure.

Step 4 Remove the upper center cover.

Step 5 Remove the slider mounting bolts (2 pieces).

► **Step 5** Removing the slider mounting bolts

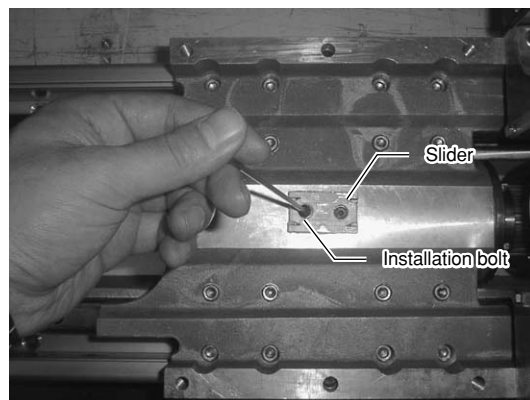
53407-A9-00

Step 6 Replace the slider.

Secure a new slider with the mounting bolts.

Step 7 Install the top center cover.

For details, see "3.1 Installing and removing the cover" in Chapter 3.



6. Maintenance parts

6.1 Consumable parts

■ T4L/T4LH

Part name	Part number		Remarks
Shutter	KDC-M229J-xxx	SHUTTER 1	50st to 400st
Insert	KDC-M2243-xxx	INSERT	Coupling resin part
Slider	KX1-M22L1-xxx	SLIDER	Slider resin part

■ T5L/T5LH

Part name	Part number		Remarks
Shutter	KDD-M229J-xxx	SHUTTER 1	50st to 800st
Insert	KDD-M2243-xxx	INSERT	Coupling resin part
Slider	KX2-M22L1-xxx	SLIDER	Slider resin part

■ T6L

Part name	Part number		Remarks
Shutter	KDE-M229J-xxx	SHUTTER 1	50st to 800st
Insert	KDD-M2243-xxx	INSERT	Coupling resin part
Slider	KX3-M22L1-xxx	SLIDER	Slider resin part

■ B10

Part name	Part number		Remarks
Belt	KY1-M225E-xxx	BELT	Motor drive unit
	KY1-M225F-xxx	BELT, STROKE	150 to 2250 (Movable part)
	KY1-M225G-xxx	BELT, STROKE	200 to 2500 (Movable part)

■ B14

Part name	Part number		Remarks
Belt	KY1-M225E-xxx	BELT	Motor drive unit
	KY2-M225F-xxx	BELT, STROKE	150 to 3050 (Movable part)
	KY2-M225G-xxx	BELT, STROKE	200 to 3000 (Movable part)

■ B14H

Part name	Part number		Remarks
Belt	KY1-M225E-xxx	BELT	Motor drive unit
	KY2-M225F-xxx	BELT, STROKE	150 to 3050 (Movable part)
	KY2-M225G-xxx	BELT, STROKE	200 to 3000 (Movable part)

Chapter 5

Wiring specifications

Contents

1. AC servo motor specifications	5-1
1.1 AC servo motor termination (T4L/T5L)	5-1
1.2 AC servo motor termination (T4LH/T5LH/T6L)	5-2
1.3 AC servo motor termination (F8/F8L/F8LH)	5-3
1.4 AC servo motor termination (T9/T9H/F10/F14/F14H/F17/F17L/F20)	5-4
1.5 AC servo motor termination (B10/B14/B14H/R5/R10/R20/F20N/N15/N18)	5-5
1.6 Brake cable specifications	5-6
2. Robot cables (DC24V specifications)	5-7
(T4L/T5L)	
2.1 Single-axis robot cables	5-7
2.1.1 Cables for ERCD	5-7
3. Robot cables (200V specifications)	5-8
(T4LH/T5LH/T6L/T9/T9H/F8/F8L/F8LH/F10/F14/F14H/F17/F17L/F20/B10/B14/B14H/R5/R10/R20)	
3.1 Single-axis robot cables	5-8
3.1.1 Cables for TS-X	5-8
3.1.2 Cables for SR1-X	5-9
3.1.3 Cables for RDX (robot with brake)	5-10
3.1.4 Cables for RDX (robot without brake)	5-12
3.2 Multi-robot cables	5-13
3.2.1 Cables for single-axis multi-robot	5-13
3.2.2 Cables for two-axis multi-robot	5-14
4. Machine harness	5-20
4.1 N15/N15D/N18/N18D	5-20
4.2 F20N	5-21
5. Cables models	5-22
5.1 Single-axis robot cables	5-22
5.2 Multi-robot cables	5-23

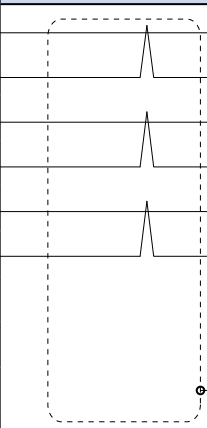
1. AC servo motor specifications

1.1 AC servo motor termination (T4L/T5L)

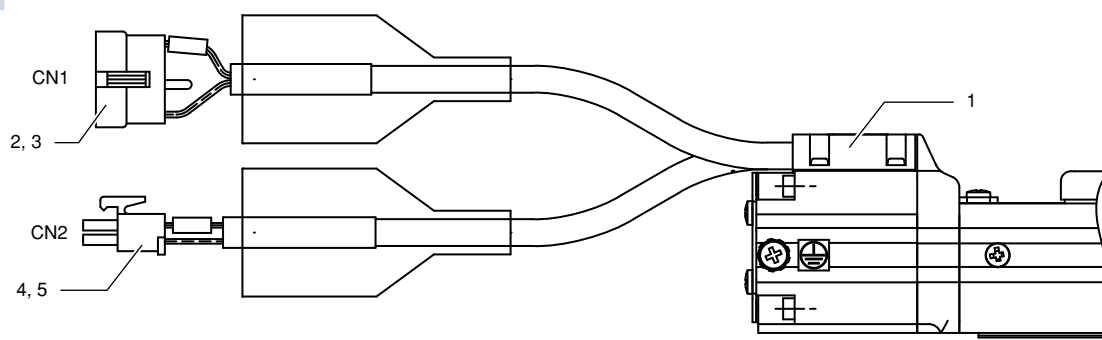
■ Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-09V-B	JST	1	CN1 (9 polarities)
3	Pin contact	SYM-001T-P0.6	JST	9	CN1
4	Receptacle housing	5557-04R	MOLEX	1	CN2 (4 polarities)
5	Receptacle	5556T	MOLEX	4	CN2

■ Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow		CN1 1
	2	S4	Blue		2
	3	S1	Red		3
	4	S3	Black		4
	5	R1	White		5
	6	R2	Green		6
	7	JP1	Red		7
	8	JP2	Red		8
	9	Shield	Grey (Heat shrinkable tube)		9
CN2	1	U	Red		CN2 1
	2	V	White		2
	3	W	Black		3
	4	PE	Yellow/Green		4

T4L/T5L



53501-A1-00

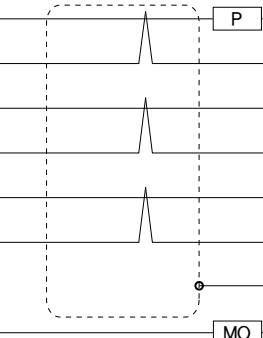
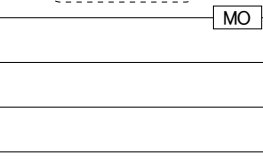
* This Fig. shows the T4L robot.

1.2 AC servo motor termination (T4LH/T5LH/T6L)

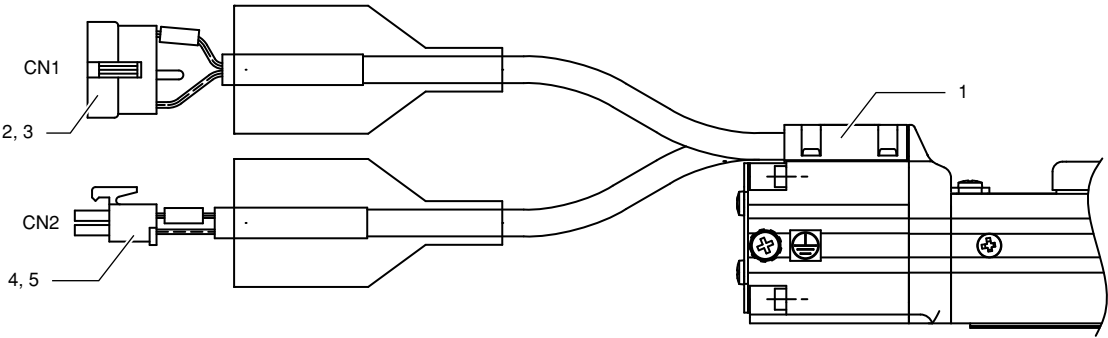
■ Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	SYM-001T-P0.6	JST	7	CN1
4	Receptacle housing	5557-04R	MOLEX	1	CN2 (4 polarities)
5	Receptacle	5556T	MOLEX	4	CN2

■ Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow		CN1 1
	2	S4	Blue		2
	3	S1	Red		3
	4	S3	Black		4
	5	R1	White		5
	6	R2	Green		6
	7	Shield	Grey (Heat shrinkable tube)		7
CN2	1	U	Red		CN2 1
	2	V	White		2
	3	W	Black		3
	4	PE	Yellow/Green		4

T4LH/T5LH/T6L



53506-A1-00

* This Fig. shows the T4LH robot.

1.3 AC servo motor termination (F8/F8L/F8LH)

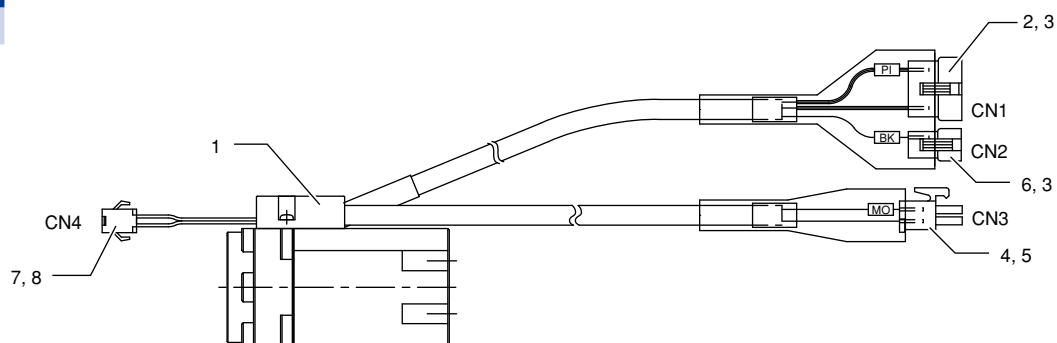
Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	SYM-001T-P0.6	JST	9	CN1.CN2
4	Receptacle housing	176273-1	AMP	1	CN3 (4 polarities)
5	Receptacle	175156-2	AMP	4	CN3
6	Receptacle housing	SMR-02V-B	JST	1	CN2 (2 polarities)
7	Plug housing	SMP-02V-BC	JST	1	CN4 (2 polarities)
8	Socket contact	SHF-001T-0.8BS	JST	2	CN4

Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow		Motor
	2	S4	Blue		
	3	S1	Red		
	4	S3	Black		
	5	R1	White		
	6	R2	Green		
	7	Shield	Grey (Heat shrinkable tube)		
CN2	1	BK	Brown		CN4 1
	2	BK	Grey		CN4 2
CN3	1	U	Red		Motor
	2	V	White		
	3	W	Black		
	4	PE	Yellow/Green		

F8/F8L/F8LH



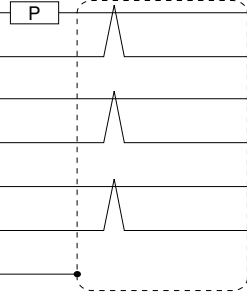
53502-A5-00

1.4 AC servo motor termination (T9/T9H/F10/F14/F14H/F17/F17L/F20)

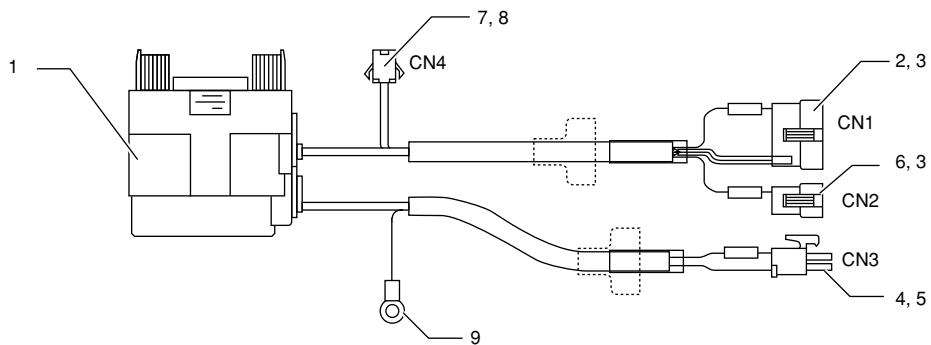
■ Connector specifications

No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	SYM-001T-P0.6	JST	9	CN1.CN2
4	Receptacle housing	176273-1	AMP	1	CN3 (4 polarities)
5	Receptacle	175156-2	AMP	4	CN3
6	Receptacle housing	SMR-02V-B	JST	1	CN2 (2 polarities)
7	Plug housing	SMP-02V-BC	JST	1	CN4 (2 polarities)
8	Socket contact	SHF-001T-0.8BS	JST	2	CN4
9	Round terminal	R1.25-4		1	

■ Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow		Motor
	2	S4	Blue		
	3	S1	Red		
	4	S3	Black		
	5	R1	White		
	6	R2	Green		
	7	Shield	Grey (Heat shrinkable tube)		
CN2	1	BK	Grey		CN4 1
	2	BK	Brown		CN4 2
CN3	1	U	Red		Motor
	2	V	White		
	3	W	Black		
	4	CG	Yellow/Green		Round terminal

T9/T9H/F10/F14/F14H/F17/F17L/F20



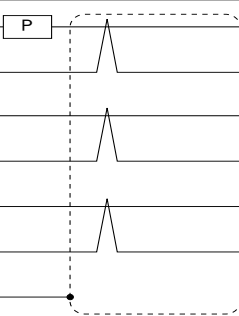
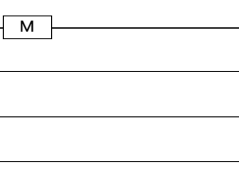
53502-A4-00

1.5 AC servo motor termination (B10/B14/B14H/R5/R10/R20/F20N/N15/N18)

■ Connector specifications

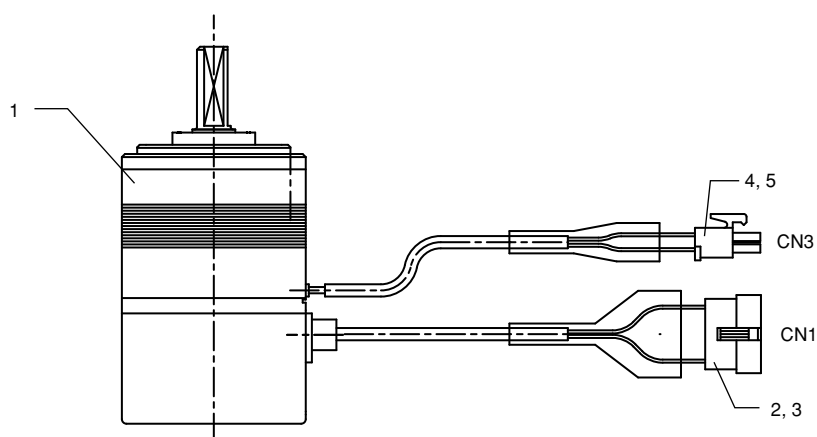
No.	Parts	Type No.	Maker	Qty	Notes
1	Servo motor			1	
2	Receptacle housing	SMR-07V-B	JST	1	CN1 (7 polarities)
3	Pin contact	SYM-001T-P0.6	JST	7	CN1
4	Receptacle housing	176273-1	AMP	1	CN3 (4 polarities)
5	Receptacle	175156-2	AMP	4	CN3

■ Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	S2	Yellow		Motor
	2	S4	Blue		
	3	S1	Red		
	4	S3	Black		
	5	R1	White (Red/White)		
	6	R2	Green (Yellow/White)		
	7	Shield	Grey (Heat shrinkable tube)		
CN3	1	U	Red		Motor
	2	V	White		
	3	W	Black		
	4	PE	Green/Yellow		

* The wire colors in () show the motor wiring of the N15/N18 robots.

B10/B14/B14H/R5/R10/R20/F20N/N15/N18



53501-AC-00

* This Fig. shows the B10 robot.

1.6 Brake cable specifications

■ Connector specifications

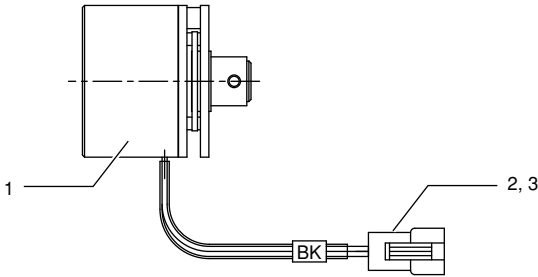
No.	Parts	Type No.	Maker	Qty	Notes
1	Brake parts			1	
2	Receptacle housing	SMR-02V-B	JST	1	CN1
3	Pin contact	SYM-001T-P0.6	JST	2	CN1

■ Connector wiring

Connector	Pin No.	Signal	Wire Color	Connection	
CN1	1	BK	Yellow (Black)		1
	2	BK	Yellow (Black)		2

* The wire colors in () show the motor wiring of the T9/T9H/F10/F14/F14H robots.

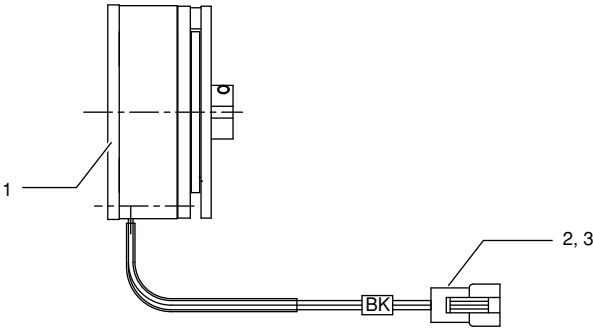
T4L/T4LH/T5L/T5LH/T6L/F8/F8L/F8LH/F17/F20



53502-A1-00

* This Fig. shows the compact brake.

T9/T9H/F10/F14/F14H



53501-A4-00

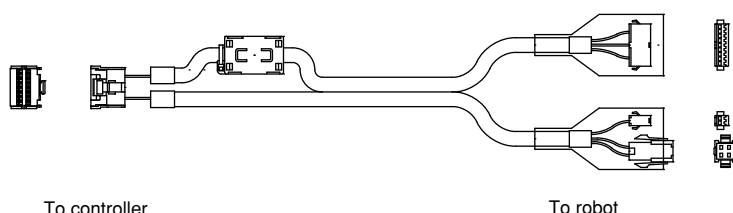
2. Robot cables (DC24V specifications)

(T4L/T5L)

2.1 Single-axis robot cables

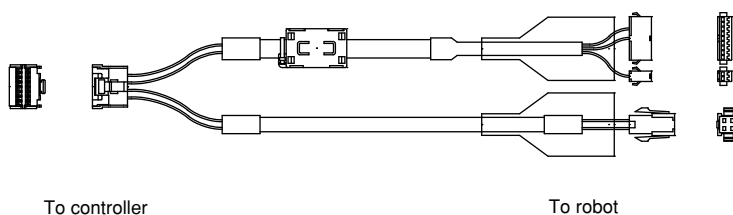
2.1.1 Cables for ERCD

Composite cable



53501-Q3-00

Composite flexing cable



53503-Q3-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller CN1	FG	4		9	Resolver	Drain wire
	S2	8		1		0.3sq Black (Red)
	S4	16		2		Yellow (White)
	S1	7		3		Blue (Green)
	S3	15		4		Orange (White)
	R1	6		5		Green (Yellow)
	R2	14		6		Brown (White)
	Faulty wiring detection 1	5		7		Grey (Blue)
	Faulty wiring detection 2	13		8		Red (White)
	U	3		1	Motor	0.75sq Red
	V	10		2		White
	W	2		3		Black
	FG	11		4		Grey (Green)
	BK+	1		1	Brake	Pink (Purple)
	BK-	9		2		Purple (White)

* The wire colors in () show the flexing cable.

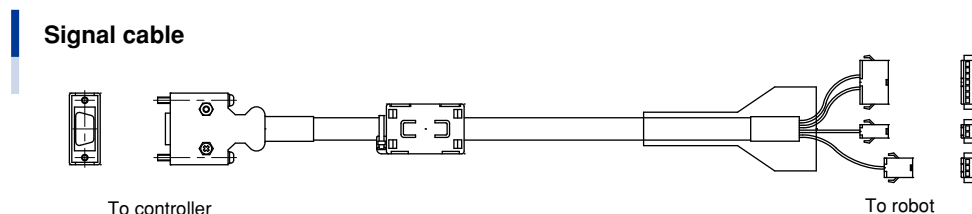
3. Robot cables (200V specifications)

(T4LH/T5LH/T6L/T9/T9H/F8/F8L/F8LH/F10/F14/F14H/F17/F17L/F20/B10/B14/B14H/R5/R10/R20)

3.1 Single-axis robot cables

3.1.1 Cables for TS-X

■ Signal cable

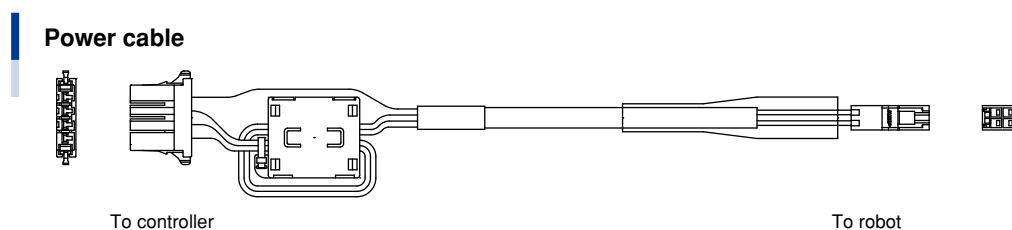


53501-M1-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller CN1						
	S2	1		1	Resolver: P	0.3sq Blue (Red)
	S4	2		2		Orange (White)
	S1	3		3		Green
	S3	4		4		Brown (White)
	R1	5		5		Grey (Yellow)
	R2	6		6		Red (White)
	FG	7		7		
						Drain wire Grey (Heat shrinkable tube)
	BK+	13		1	Brake: BK	Black (Blue)
	BK-	14		2		Yellow (White)
	ORG	12		2	ORG	Pink (Purple)
	24V	11		1		White (Blue)
	GND24	10		3		Blue Red (Brown)

* The wire colors in () show the flexing cable.

■ Power cable

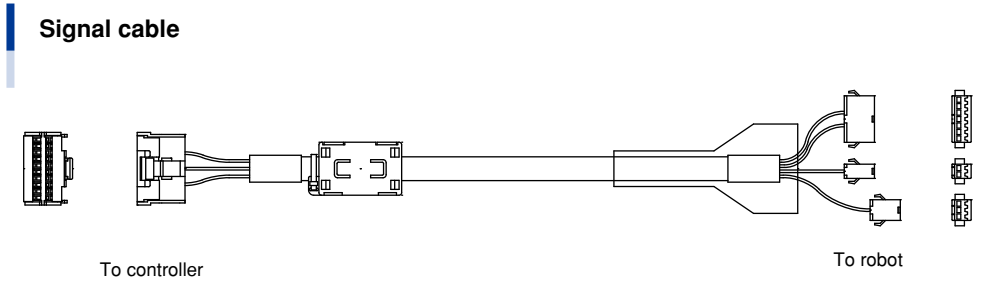


53503-M1-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	FG	1		4	Motor: M	0.75sq Gray
	U	2		1		Red
	V	4		2		White
	W	3		3		Black

3.1.2 Cables for SR1-X

■ Signal cable

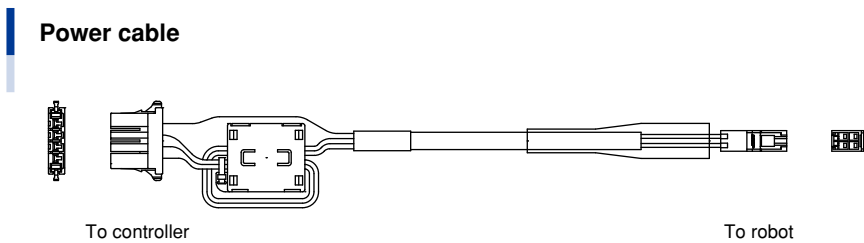


53501-Q6-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller CN1						
	S2	1		1	Resolver: P	0.3sq Blue (Red)
	S4	2		2		Orange (White)
	S1	3		3		Green
	S3	4		4		Brown (White)
	R1	5		5		Grey (Yellow)
	R2	6		6		Red (White)
	FG	9		7		Grey (Heat shrinkable tube)
	BK+	17		1	Brake: BK	Black (Blue)
	BK-	18		2		Yellow (White)
	ORG	12		2	ORG	Pink (Purple)
	24V	13		1		White (Blue)
	GND24	15		3		Blue Red (Brown)

* The wire colors in () show the flexing cable.

■ Power cable



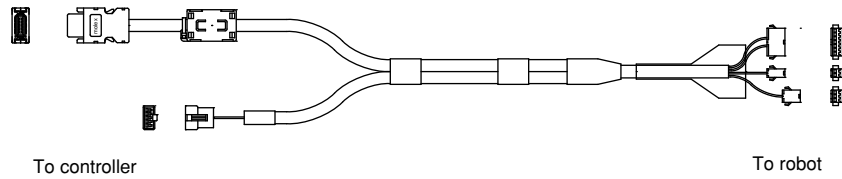
53503-Q6-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	FG	1		4	Motor: M	0.75sq Gray
	U	2		1		Red
	V	4		2		White
	W	3		3		Black

3.1.3 Cables for RDX (robot with brake)

■ Signal cable

Signal cable



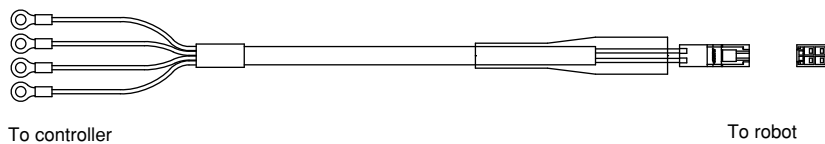
53501-N1-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller ENC	S2	5		1	Resolver: P	0.3sq Blue (Red)
	S4	6		2		Orange (White)
	S1	7		3		Green
	S3	8		4		Brown (White)
	R1	1		5		Grey (Yellow)
	R2	2		6		Red (White)
	FG			7		Drain wire Grey (Heat shrinkable tube)
Brake	BK+	1		1	Brake: BK	0.3sq Blue (Red)
	BK-	2		2		Orange (White)
					ORG	
	24V	3		1		0.3sq Green
	ORG	4		2		Grey (Yellow)
	GND24	5		3		Red (White)

* The wire colors in () show the flexing cable.

■ Power cable

Power cable

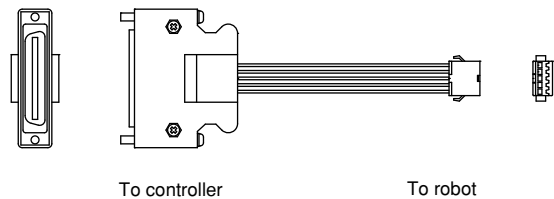


53504-N1-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	U	1			Round terminal	0.75sq Red
	V	2				White
	W	3				Black
	FG	4				Grey (Heat shrinkable tube)

■ **ORG, BK wires**

ORG, BK wires



53506-N1-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller I/O	BK+	13		1	To robot	0.3sq Black
	BK-	31		2		Black
	24V	1		3		Black
	ORG	8		4		Black
	GND24V	10		5		Black

3.1.4 Cables for RDX (robot without brake)

■ Signal cable

Signal cable



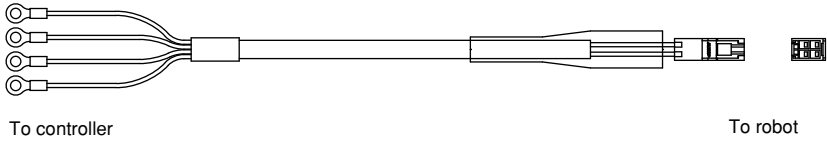
53509-N1-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller ENC	S2	5		1	Resolver: P	0.3sq Blue (Red)
	S4	6		2		Orange (White)
	S1	7		3		Green
	S3	8		4		Brown (White)
	R1	1		5		Grey (Yellow)
	R2	2		6		Red (White)
	FG			7		Drain wire Grey (Heat shrinkable tube)

* The wire colors in () show the flexing cable.

■ Power cable

Power cable



53511-N1-00

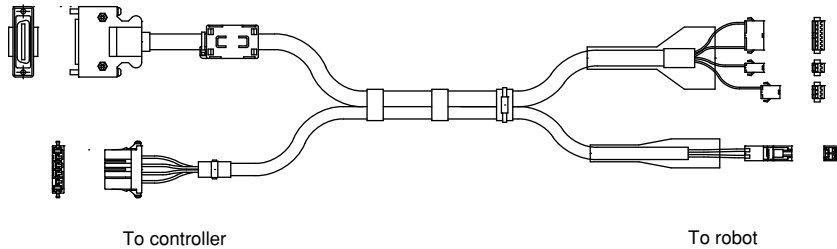
Parts	Signal	PIN	Connection	PIN	Parts	Wire
Motor wire	U	1			Round terminal	0.75sq Red
	V	2				White
	W	3				Black
	FG	4				Grey (Heat shrinkable tube)

3.2 Multi-robot cables

3.2.1 Cables for single-axis multi-robot

■ Connection controller : RCX240

Cables for multi-robot



53501-Q0-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller ROB I/O ZR	S2	1		1	Resolver: P3	0.3sq Red
	S4	2		2		White
	S1	3		3		Green
	S3	4		4		White
	R1	5		5		Yellow
	R2	6		6		White
	FG	7		7		Drain wire
	MB+	14		1	Brake: BK3	0.3sq Blue
	MB-	16		2		White
	24V					
	ORG	12		1	ORG3	Purple
	GND24	13		2		Blue
	HLIM	10		3		Brown
	GND24	11				Gray
	HLIM	28				Gray
	GND24	29				
Controller MOTOR ZM	U	2		1	Motor: M3	0.75sq Red
	V	3		2		White
	W	4		3		Black
	FG	1		4		Gray

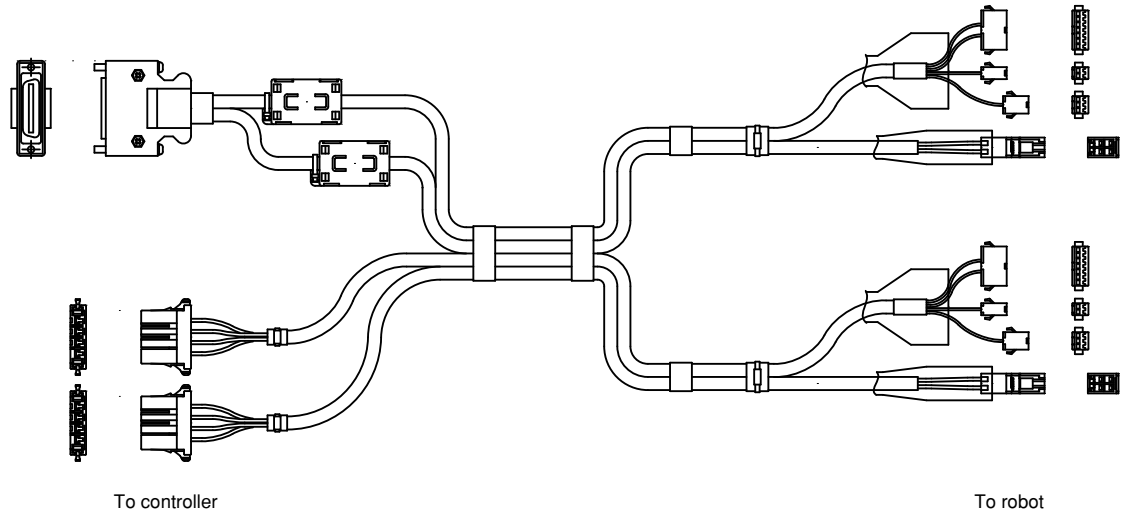
This cable is connected to the ZR connector of the ROB I/O and the MOTOR ZM connector.

3.2.2 Cables for two-axis multi-robot

1. Robot combination: 1st axis is FLIP-X and 2nd axis is FLIP-X.

■ Connection controller : RCX221/222/240

Cables for multi-robot



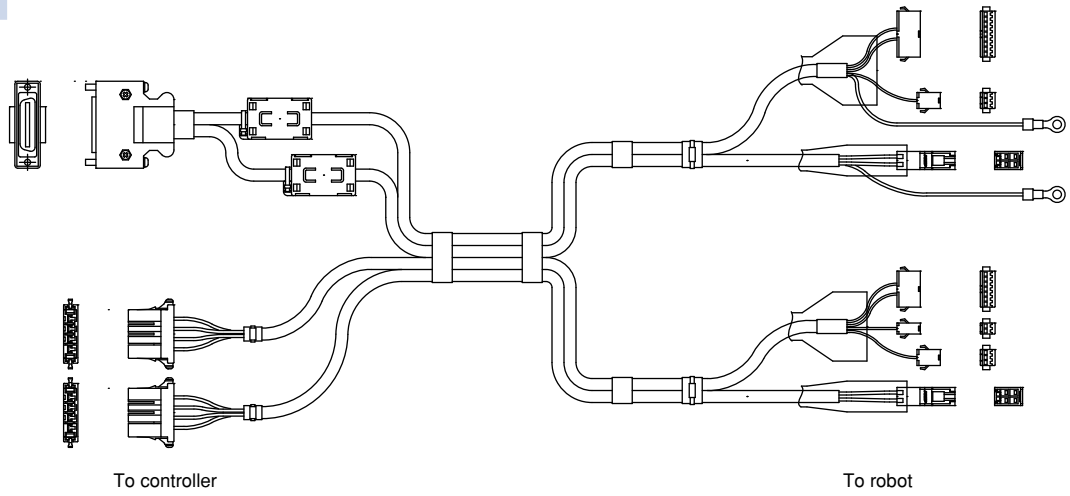
53501-R2-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Controller ROB I/O XY(ZR)	S2	1		1	Resolver: P1	0.3sq	Red
	S4	2		2		White	
	S1	3		3		Green	
	S3	4		4		White	
	R1	5		5		Yellow	
	R2	6		6		White	
	DG	7		7		Drain wire Grey (Heat shrinkable tube)	
	MB+	14		1	Brake: BK1	Blue	
	MB-	16		2		White	
	24V	9			ORG1		
				1		Purple	
	ORG	12		2		Blue	
	GND24	13		3		Brown	
	S2	19		1	Resolver: P2	Red	
	S4	20		2		White	
	S1	21		3		Green	
	S3	22		4		White	
	R1	23		5		Yellow	
	R2	24		6		White	
	DG	25		7		Drain wire Grey (Heat shrinkable tube)	
	MB+	32		1	Brake: BK2	Blue	
	MB-	34		2		White	
	24V	27			ORG2		
				1		Purple	
	ORG	30		2		Blue	
	GND24	31		3		Brown	
	HLIM	10				0.3sq	Grey
	GND24	11					
	HLIM	28				0.3sq	Grey
	GND24	29					
Controller MOTOR XM(ZM)	U	2		1	Motor: M1	0.75sq	Red
	V	3		2		White	
	W	4		3		Black	
	FG	1		4		Grey (Heat shrinkable tube)	
Controller MOTOR YM(RM)	U	2		1	Motor: M2	0.75sq	Red
	V	3		2		White	
	W	4		3		Black	
	FG	1		4		Grey (Heat shrinkable tube)	

2. Robot combination: 1st axis is PHASER and 2nd axis is FLIP-X.

■ Connection controller : RCX221/240

Cables for multi-robot



53501-R0-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Controller ROB I/O XY(ZR)	S+	1		1	Linear: P1	0.3sq	Red
	S-	2		2			White
	C+	3		3			Green
	C-	4		4			White
	Z+	10		5			Yellow
	Z-	11		6			White
	+5V	6		7			Blue
	DG	5		8			White
	FG	7		9		Drain wire Grey (Heat shrinkable tube)	
	FG					0.75sq	Gray
	24V	9			ORG1	0.3sq	
	ORG	12		1			Purple
	GND24	13		2			Blue
	S2	19		3			Brown
	S4	20		1	Resolver: P2		Red
	S1	21		2			White
	S3	22		3			Green
	R1	23		4			White
	R2	24		5			Yellow
	FG	25		6			White
	MB+	32		7		Drain wire Grey (Heat shrinkable tube)	
	MB-	34		1	Brake: BK2	0.3sq	Blue
	24V	27		2			White
	ORG	30			ORG2		
	GND24	31		1			Purple
	HLIM	28		2			Blue
	GND24	29		3			Brown
						0.3sq	Gray
Controller MOTOR XM(ZM)	U	2		1	Motor: M1	0.75sq	Red
	V	3		2			White
	W	4		3			Black
	FG	1				Grey (Heat shrinkable tube)	
Controller MOTOR YM(RM)	U	2		1	Motor: M2	0.75sq	Red
	V	3		2			White
	W	4		3			Black
	FG	1		4		Grey (Heat shrinkable tube)	

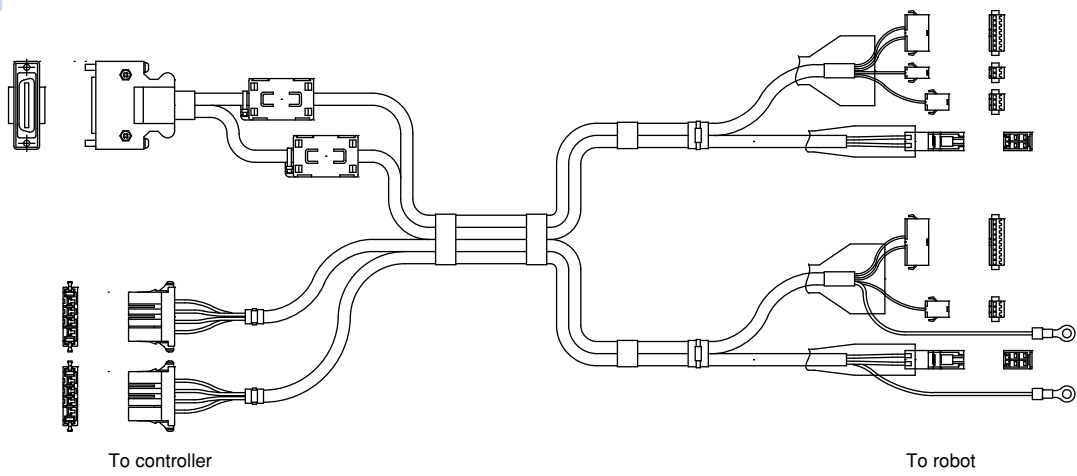
When connected to the XY of the ROB I/O, connect to the MOTOR XM and YM.

When connected to the ZR of the ROB I/O, connect to the MOTOR ZM and RM.

3. Robot combination: 1st axis is FLIP-X and 2nd axis is PHASER.

■ Connection controller : RCX221/240

Cables for multi-robot



53503-R0-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire
Controller ROB I/O XY(ZR)	S2	1		1	Resolver: P1	0.3sq Red
	S4	2		2		White
	S1	3		3		Green
	S3	4		4		White
	R1	5		5		Yellow
	R2	6		6		White
	FG	7		7		Drain wire Grey (Heat shrinkable tube)
	MB+	14		1	Brake: BK1	0.3sq Blue
	MB-	16		2		White
	24V	9			ORG1	0.3sq
				1		Purple
	ORG	12		2		Blue
	GND24	13		3		Brown
	S+	19		1	Linear: P2	0.3sq Red
	S-	29		2		White
	C+	21		3		Green
	C-	22		4		White
	Z+	2		5		Yellow
	Z-	29		6		White
	+V5	24		7		Blue
	DG	23		8		White
	FG	25		9		Drain wire Grey (Heat shrinkable tube)
	FG					0.75sq Gray
	24V	27			ORG2	
				1		Purple
	ORG	30		2		Blue
	GND24	31		3		Brown
	HLIM	10				Grey
	GND24	11				
Controller MOTOR XM(ZM)	U	2		1	Motor: M1	0.75sq Red
	V	3		2		White
	W	4		3		Black
	FG	1		4		Grey (Heat shrinkable tube)
Controller MOTOR YM(RM)	U	2		1	Motor: M2	0.75sq Red
	V	3		2		White
	W	4		3		Black
	FG	1				Grey (Heat shrinkable tube)

When connected to the XY of the ROB I/O, connect to the MOTOR XM and YM.

When connected to the ZR of the ROB I/O, connect to the MOTOR ZM and RM.

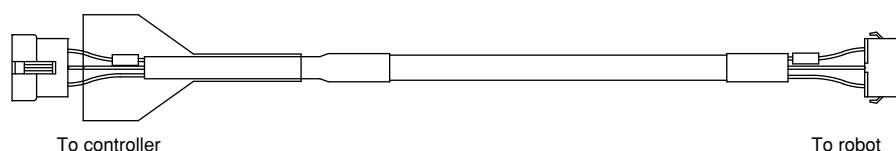
4. Machine harness

The following shows the wiring inside the cable carrier.

4.1 N15/N15D/N18/N18D

■ Signal cable

Signal cable

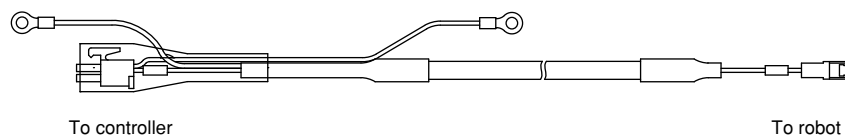


53501-AA-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Encoder P1	S2	1		1	Resolver	0.3sq	Red
	S4	2		2			White
	S1	3		3			Green
	S3	4		4			White
	R1	5		5			Yellow
	R2	6		6			White
	D.G.	7		7		Drain wire Grey (Heat shrinkable tube)	

■ Power cable

Power cable



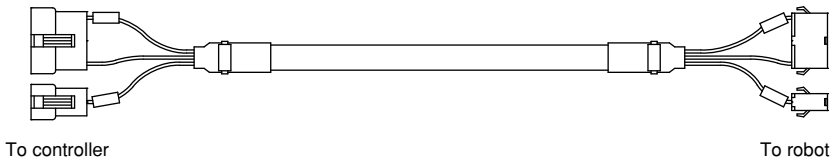
53503-AA-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Motor wire	U	1		1	Motor	0.75sq	Red
	V	2		2			White
	W	3		3			Black
	FG			4			Green/Yellow
	FG	4					Green/Yellow

4.2 F20N

■ Signal cable

Signal cable

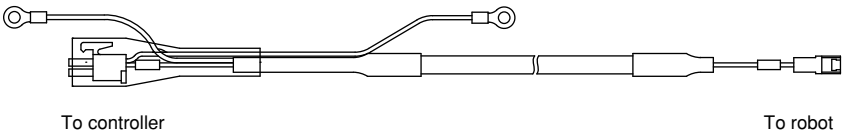


53501-A9-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Encoder P	S2	1		1	Resolver	0.3sq	Red
	S4	2		2			White
	S1	3		3			Green
	S3	4		4			White
	R1	5		5			Yellow
	R2	6		6			White
	D,G.	7		7		Drain wire Grey (Heat shrinkable tube)	
Brake BK	24V	1		1	Brake : BK	0.3sq	Blue
	GND24	2		2			White

■ Power cable

Power cable



53503-A9-00

Parts	Signal	PIN	Connection	PIN	Parts	Wire	
Motor wire	U	1		1	Motor	0.75sq	Red
	V	2		2			White
	W	3		3			Black
	FG			4			Green/Yellow
	FG	4					Green/Yellow

5. Cables models

5.1 Single-axis robot cables

■ Cables for ERCD

Cable type	Set model number	Individual part model number	
Standard cable	—	Composite cable	KX1-M4751- □ 0
Flexing cable	—	Composite cable	KX1-M4752- □ 0

■ Cables for TS-X

Cable type	Set model number	Individual part model number	
Standard cable	KBY-M4710- □ 0	Signal cable	KBY-M4751- □ 0
		Power cable	KX7-M4752- □ 0
Flexing cable	KBY-M4720- □ 0	Signal cable	KBY-M4755- □ 0
		Power cable	KX7-M4752- □ 0

■ Cables for SR1-X

Cable type	Set model number	Individual part model number	
Standard cable	KX7-M4710- □ 0	Signal cable	KX7-M4751- □ 1
		Power cable	KX7-M4752- □ 0
Flexing cable	KX7-M4720- □ 0	Signal cable	KX7-M4755- □ 0
		Power cable	KX7-M4752- □ 0

■ Cables for RDX (robot with brake)

Cable type	Set model number	Individual part model number	
Standard cable	KBH-M4720- □ B	Signal cable	KBH-M4753- □ 0
		Power cable	KBH-M4752- □ 0
		ORG, BK cable	KBH-M4421-00
Flexing cable	KBH-M4740- □ B	Signal cable	KBH-M4757- □ 0
		Power cable	KBH-M4752- □ 0
		ORG, BK cable	KBH-M4421-00

■ Cables for RDX (robot without brake)

Cable type	Set model number	Individual part model number	
Standard cable	KBH-M4710- □ A	Signal cable	KBH-M4751- □ 0
		Power cable	KBH-M4752- □ 0
		I/O connector	KBH-M4420-00
Flexing cable	KBH-M4730- □ A	Signal cable	KBH-M4756- □ 0
		Power cable	KBH-M4752- □ 0
		I/O connector	KBH-M4420-00

5.2 Multi-robot cables

■ Cables for single-axis multi-robot

Connection controller : RCX240

Cable type	Cable model number
Flexing cable	KX7-M4754- □ 0

■ Cables for two-axis multi-robot

Connection controller : RCX222/RCX240

Cable type	Robot combination		Cable model number
	1st axis	2nd axis	
Flexing cable	FLIP-X	FLIP-X	KX7-M4753- □ 1

Connection controller : RCX240

Cable type	Robot combination		Cable model number
	1st axis	2nd axis	
Flexing cable	PHASER	FLIP-X	KAU-M4754- □ 2
	FLIP-X	PHASER	KAU-M4756- □ 2

The number in □ shown in the model number has the following meaning.

Number in □	Cable length
1 *	1m
3	3.5m
5	5m
A	10m

* Cables for ERCD only

Revision record

Manual version	Issue date	Description
Ver. 1.00	Jun. 2012	First edition
Ver. 1.01	Jul. 2012	"2.1 T4L/T4LH/T5L/T5LH/T6L" was added to "2. Replacing the motor" in Chapter 4. "3. Replacing the insert" was added to Chapter 4. Erroneous descriptions were corrected.

Maintenance Manual

Single-axis Robots

FLIP-X Series

Jul. 2012

Ver. 1.01

This manual is based on Ver. 1.01 of Japanese manual.

YAMAHA MOTOR CO., LTD. IM Operations

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IM Operations

882 Soude, Nakaku, Hamamatsu, Shizuoka, 435-0054, Japan
Tel. 81-53-460-6103 Fax. 81-53-460-6811

Robot manuals can be downloaded from our company website.
Please use the following for more detailed information.

<http://www.yamaha-motor.co.jp/global/industrial/robot/>



YAMAHA

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